TAMPERE UNIVERSITY OF TECHNOLOGY

DANIEL PRYJMA

SUPPLIER BASE REDUCTION PROCESS
Master of Science Thesis

Prof. Miia Martinsuo has been appointed as the examiner at the Council Meeting of the Faculty of Business and Technology Management on August 17th, 2011

ABSTRACT

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Industries have been undergoing several trend changes in the past decades, two of which are relevant for this study: outsourcing and mergers and acquisitions. Outsourcing allows companies to focus on doing what they are best at; and mergers and acquisitions are a way of increasing presence in the market and achieving fast growth. Several companies in the world followed both of these trends, including Sandvik Mining and Construction (SMC), and one of the common consequences seen is the increase of the supplier base.

The objectives of this thesis are to develop a framework for targeting suppliers to be eliminated and a process for eliminating such suppliers. It discusses supplier management in general, including selection and elimination of suppliers, as well as supplier base expansion. Several employees in SMC were interviewed, from sourcing to production and from operation level do middle management. A theoretical framework was developed and tested. In addition, a process for eliminating suppliers was created in the form of a flowchart.

A sample of 200 suppliers was given and a test period of six months stipulated. Of those, 37% were targeted to be eliminated from the supplier base. However, this process has a high stakeholder involvement required, which impacted severely on the success of the project. Some cases seen are of suppliers labeled as “special”, resistance against the project by some employees or low priority of the project. Hence, it was determined that either the company is not ready to undertake such process, or that a stronger management involvement is necessary. By the time the thesis was published a rate of elimination of 3% was verified.

PREFACE

This study was performed as a continuation from a previous study done for Sandvik Mining and Construction (SMC). The idea of this paper started from discussions with András Huszta about sourcing and its issues in SMC. In order to support the research, several meetings were conducted with employees from different departments and hierarchical levels. The objective for this study was to determine a systematic way of reducing the number of suppliers.

During this research process I had several hours spent in SMC, researching, documenting, meeting and arguing with colleagues trying to prove that my cause was worth taking part in. During the whole process András Huszta provided me enough guidance and help, hence, I would like to thank him. In addition, I place my gratitude to several SMC workers who gave some of their valuable time to help me in my research, in special Béatrice Rispal, Niall Collins and Nicolas Tixier. Also, I would like to thank my supervisor Dr. Miia Martinsuo for the valuable comments, revisions and guidance.

Special thanks go to my whole family, in special for my parents, whose moral, emotional and financial support was more than what I could have ever hoped for, and it was crucial for me to achieve everything that I have achieved in my life. Last but not least, to Doris, this would not have been possible without her.

Tampere, August 2011

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Daniel Pryjma

CONTENTS

LIST OF ABBREVIATIONS

B2B	Business to Business
ERP	Enterprise Resource Planning
IT	Information Technology
M&A	Mergers and Acquisitions
PDM	Product Data Management
PU	Production Unit
R&D	Research and Development
RfQ	Request for Quotation
SMC	Sandvik Mining and Construction
TQM	Total Quality Management
VMC	Vehicle and Mechanical Components
VSS	Vendor Selection System

1 INTRODUCTION

1.1 Supplier relations

Outsourcing has become one mega-trend in business during the past decades (Ogden and Carter, 2008). This trend has increased the importance of both supply chain management and sourcing departments. With the focus in this area, businesses have changed their ways of operating, as well as their income statement structure. With the focus on outsourcing, companies have their biggest cost related to purchasing, which also means that the biggest savings can be found in purchasing. Another big trend in the business world has been the one of acquisitions in order to accelerate a company's growth (Davidson, 1981). When a company acquires another company, the transaction comprises the fully working company. Hence, employees, suppliers and the full supply chain of the acquired company are added to the new owner.

Combining these two trends, it is possible to get the global picture of companies that passed through this sort of development. Sandvik Mining and Construction (later referred to as SMC) has such a history, which has led to success, but also to a vast number of suppliers. On one hand, having a big supplier database can reduce supplying risks and provide opportunities for finding cheaper sources. However, it also leads to an increase in indirect costs, such as invoice handling, account management, receiving and freight costs (Choi and Krause, 2006; Jonsson and Zineldin, 2003). On the other hand, it can result in poor management and difficult relations. Despite the trend of mergers and acquisitions, there is a gap in literature concerning supplier reduction processes and approaches (Ogden and Carter, 2008). In addition, with single sources of supply it is possible to increase quality, reduce inventory, develop just-in-time systems, as well as decrease the time to market of products (Wilson, 1995). Wilson (1995) also argues that it is impracticable to achieve the conditions just mentioned with multiple sources of supply.

The automotive industry has been setting standards for all industries over the past decades, especially since the raise of Toyota in the 1970s. Several other industries do not have such high volumes or are not as standardized and modularized as the automotive industry, hence some of the principles do not apply. In the case of mining and construction, the main reason why the automotive industry models cannot be fully imported is the difference in volume and customization options. However, that does not mean that some

principles cannot be applied, and for the purpose of this thesis the Toyota concepts in sourcing will be called Lean Sourcing.

Regarding the indirect cost issues, supplier base reduction can have a very interesting approach. When considering all the indirect costs of a supplier base, it can be assumed that by reducing the supplier base by half the indirect costs will also be dropped by half. However, in reality these issues have much more complicated implications, and it does not mean that the company can just lay-off 50% of its sourcing workers, once it cuts the amount of suppliers by half (Ferrin and Plank, 2002). Yet, while working with supplier base reduction it is expected that the costs will be reduced, however, the exact amount is very difficult to estimate and the numbers are not necessarily directly related.

1.2 Research objectives

With the focus on purchasing and cost reduction, SMC has developed the interest in reducing the number of suppliers. There are several issues that need to be considered when reducing suppliers, such as the complexity of items purchased, annual expenditure and geographic location (Clarke and Freytag, 2008). Handling local suppliers is simpler for companies for several reasons, which include same language, proximity and smaller lead times. However, when considering a global company with complex internal and external relations, having too many local suppliers can complicate the communication, e.g. because of different language, and increase the cost of management. Nevertheless, it is not possible to simply terminate the supply relationship, a deeper study is needed, as each case is different. In addition, there are several “softer” issues when dealing with suppliers that cannot be measured (Jonsson and Zineldin, 2003; Araujo et al., 1999). Trust and personal relations are examples of such soft issues.

Even though supplying relations tend to be very complex, companies are dynamic and these relations have to be maintained, created and terminated constantly. The focus of this study will be on terminating supplying relationships, specifically on how to target and determine which suppliers are to be eliminated from a company’s portfolio. Therefore, the objective of this study is *“to analyze the situation in Sandvik Mining and Construction to propose a systematic way of reducing the number of suppliers.”*

Specifically, the goal of this study is to answer the following research questions:

1. How can a process such as supplier base reduction be standardized?

2. What are all the stakeholders involved in such kind of project and what kind of cooperation is needed from them?

3. What kind of subjective data are needed in a supplier base reduction process?

4. Is SMC ready to take part and invest in supplier base reduction?

To summarize, a brief description of each research question is going to be made. First, the idea behind the first question is whether or not it is possible to reduce the amount of suppliers by creating and standard method. This study will try to understand if suppliers can be treated as the data found in databases or if there are hidden facts that must be considered case by case. Second, the variables involved encompass the departments and key-people on the process as well as supplier/partner characteristics such as size and amount of products supplied. Third, this question is related to the first one, in case it is possible to elaborate an objective method to reduce the amount of suppliers, will it really be possible to apply this method in reality? Or are there other variables that make suppliers “special” and cannot be seen unless the supplier managers are involved in the process. Finally, the last question is related to if all the previous research questions give satisfactory results, is SMC ready to take part in this project? This question is very relevant once that if the stakeholders involved in the process are not ready to develop such project and cooperate with it, it would be impossible to proceed.

1.3 Scope of the study

Supplier relations have evolved over time from transaction based into relationship based. The latter is known to have more advantages and to provide the buying company with a safer perspective. Therefore, these relations have become part of companies’ strategies and are more and more emphasized. In addition, to maintain partnerships that generate win-win situations a reasonable investment is required in personnel and relationship management. Hence, the fewer suppliers a company can have the better. Nevertheless, in order to be able to reduce the number of suppliers a defined and standardized process is of great help. This is the scope of this thesis: to determine a standardized process to reduce the number of suppliers in SMC. Yet, in order to understand the criteria utilized to eliminate suppliers, it is necessary to understand what the basic supplier cycle, from selection to elimination is. Also, the theory part will examine the sourcing perspective with topics such as supplier positioning and management.

In a broader level, for the company, this project is a pilot project that aims to determine or to start the creation of a supplier reduction process. As discussed previously, SMC experienced an intense period of mergers and acquisitions that resulted in growth for the company. Nevertheless, as a negative side of such process, the company was faced with an enormous increase in the amount of suppliers, once each acquired company had their own means of obtaining components. Therefore, SMC in general is in need to define a process of targeting and eliminating the most susceptible suppliers in order to achieve a manageable amount. However, this project focuses in the vehicle and mechanical (VMC) components for the logistics unit of the company as shown in the Figure 1 below. The logistics unit provides customers with after-sales components and, within the company, internal purchases.

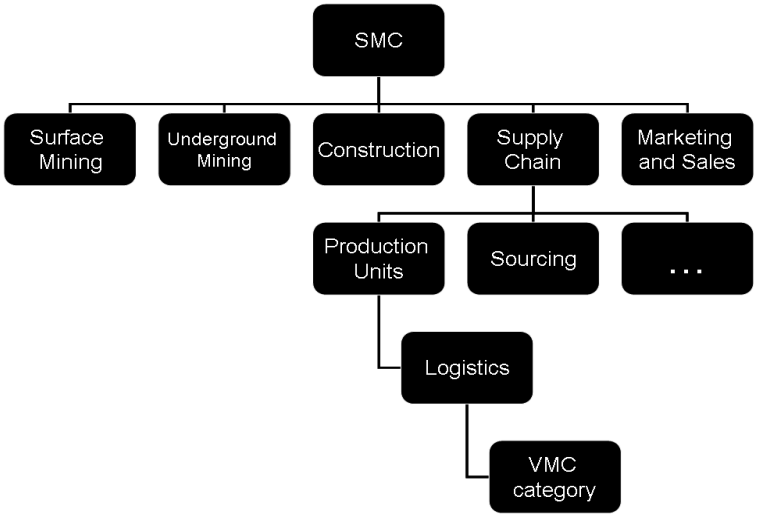

Figure 1. Scope of the thesis in SMC.

In addition to the category limitation, there were other delimitations for this study. As this was a short term project, R&D involvement was avoided due to the necessity of high stakeholder involvement. Also, the project tried to focus on repeated products, double entry suppliers and commercial parts. Nevertheless, when some urgent cases appeared, they were also handled once they showed up as priorities. To summarize, the scope of this thesis is to develop and test a process to reduce the number of suppliers in the VMC category in the logistics unit of SMC. The research structure is presented in the following section.

1.4 Research structure

This study approaches many different subjects and concepts at different levels. In order to ease the reader's understanding, this thesis was divided into seven chapters. The contents approached by this research are presented as follows:

1. *Chapter 1* contextualizes the topic studied along with the research purpose and objectives. The research questions are also introduced, as well as the scope of the study.

2. *Chapter 2* aims to give the reader a basic understanding on how a supplier base cycle is formed, starting from the selection of suppliers, passing by forms of expanding the supply base and finishing by the methods of reducing the amount of suppliers in a company. It also introduces important sourcing issues, such as lean sourcing and commitment and trust. Also, it explains about relationship management with suppliers and the chapter finishes by determining the most relevant criteria for supplier elimination.

3. *Chapter 3* explains the research methods such as data gathering methods, and framework development process and implementation.

4. *Chapter 4* describes the case company, Sandvik Mining and Construction, its origins and consolidation process. Also, the company interface is detailed as well as the range of the study within SMC.

5. *Chapter 5* presents the results found with the research. It includes the approach taken, the framework and process developed during the research period.

6. *Chapter 6* concludes and discusses the results achieved in this study. It presents the general conclusions, as well as limitations of the study and potential for future research and the project's successes and failures.

As mentioned previously the following chapter will discuss the supplier cycle within a company, from selection to forms of elimination, passing by supplier base expansion.

2 MANAGING THE SUPPLIER BASE

This chapter introduces important issues on the supplier base management. It begins with a determining a method for selecting suppliers and the most important criteria involved in such. The chapter is followed by a section determining some requirement towards suppliers, such as commitment and trust and lean sourcing. Then, forms of expanding the supplier base are introduced, as well as the reasons for having a big supplier base. The fourth section approaches the supplier relationship management, with items such as supply positioning and interfaces between buyer and seller company. This section finishes by presenting a combined model to position suppliers and understand what the best interface to manage them is. The fifth section introduces different forms for reducing the supplier base in different contexts of different industries, the four forms are systematic elimination, standardization, tiering and bundling. Then, the next section determines the most relevant criteria to select suppliers to be eliminated from the supplier base. Finally, the chapter finishes with a summary of all the literature introduced.

2.1 Supplier selection

As mentioned previously, there is a big trend in business to outsource components and subassemblies, and companies have big debates between the make or buy decision (Ogden and Carter, 2008). Once the buy decision has been made, the most important step is to determine who the optimal partner for each buy decision is (Choi and Hartley, 1995). Also, there are options towards the type of relationship, long or short term, R&D involvement or not, among others. Therefore, supplier selection is one of the most important decisions made in sourcing departments. Reasons for such importance include but are not limited to: quality, lead times, production risk, customer satisfaction and price. This section discusses the literature on supplier selection from many different angles.

2.1.1 First model

Choi and Hartley (1995) studied “one of the most fundamental responsibilities of supplier management – supplier selection”. Their study was based on interviews made with purchasing managers in the automotive industry. Surprisingly, studies made prior to the mid-1990s did not incorporate crucial issues to supplier selection such as closeness of the relationship and continuous improvement capabilities (Choi and Hartley, 1995). Based on their

interviews across the automotive industry supply chain, the authors determined the eight most relevant criteria when selecting new suppliers. The list of criteria presented by Choi and Hartley (1995), in order of importance (from most important to least important), is shown in the list below:

1. Consistency
2. Reliability
3. Relationship
4. Technological Capability
5. Flexibility
6. Price
7. Service
8. Finances

First, the consistency is connected to product/service quality, delivery accuracy and timely response to questions. *Second*, reliability is related to commitment, possibilities of improvement and product liability. *Third*, relationship has four variables: long-term relationship, closeness of the relationship, openness in communication and reputation of integrity or trust. *Fourth*, technological capability is directly related to the outsourcing trend seen in the automotive industry, as companies buy sub-assemblies that were completely developed by their suppliers. This criterion is divided in design and technical capability. *Fifth*, flexibility shows a supplier capability of reacting towards change or problems, this is divided in four dimensions: product volume changes, short set-up time, short delivery lead-time and capability of conflict resolution. *Sixth*, price dimension is very simple, it is only influenced by a low initial price of the components/services. *Seventh*, services are surprisingly low ranked, perhaps due to the fact that in the past years there was a shift towards a service society, and more and more companies use service as a competitive advantage. In the case of the study performed by Choi and Hartley (1995) it only has two dimensions, after-sales support and sales representative's competence. Finally, *eighth* are finances which evaluate the suppliers' financial conditions and the likelihood these companies will have of continuity in their business.

These results go against the common belief that price is the most important issue in purchasing, or at least show a shift in importance of quality vs. price. This shift is due to the examples showed by the Japanese automotive industry, where due to high quality and several other practices, prices were reduced naturally (Stevenson, 2008). Also, it can be noticed that services and finances were not priority in the mid-1990s. Perhaps, due to the change in the economic scenario view in the past five years in the global economy these would be ranked differently is this study was performed in the present time.

2.1.2 Second model

Pryjma (2010) did a study in dealer selection criteria and determined which the most relevant criteria when selecting dealing representatives overseas are. Interpreting dealers as partners, it is possible to realize how similar the two types of relations are. Derived from Cavusgil et al. (1995); Jonsson and Zineldin (2003); Lin and Chen (2008) and Wilson (2002), Pryjma (2010) established the most important measures to be used when choosing a dealer in a foreign country. The result obtained by modifying these criteria to the selection of suppliers the result seen is presented in Table 1. This table presents all the criteria chosen as the most relevant in the supplier selection, as well as from which source they were based on.

Table 1. Dealer selection criteria (modified from Pryjma, 2010)

Group	Criterion	Cavusgil et al.	Jonsson and Zineldin	Lin and Chen	Wilson
Resources	Technical	x		x	x
	Financial	x		x	x
	Commercial	x		x	x
	Language	x			x
Services	Customer service	x		x	
	After sales/ Warranty			x	x
Market	Geographical Coverage	x		x	x
	Reputation		x	x	x
	Trust		x		

To facilitate the analysis, the criteria presented are combined in three groups: resources, services and access to the market. This division is presented in order to make the supplier evaluation easier by concentrating on each group individually. The first group, resources, refers to knowledge and physical resources. The second group, services, evaluates the existence and quality of services provided by the supplier. Finally, the third group relates to market issues, such as coverage, dealer reputation and trust. Reputation and trust are directly connected in the first contact, but as the relationship progresses they become independent (Jonsson et al., 2003).

2.1.3 Third model

Masella and Rangone (2000) did an extensive study in supplier selection or, as they call it, vendor selection. According to their study vendor selection systems (VSS) are dynamic systems that contain basically three variables *input variables*, *state variables* and *output variables*. This study aims to determine which variables should be taken into account when choosing suppliers to have a short or long term relationship with the buying firm. Masella and Rangone (2000) argue that depending on the focus of the buying company some criteria should be more emphasized than others, yet the criteria presented are always the same.

These three variables mentioned control the behavior of suppliers. In other words, by understanding these three variables it is possible to interpret what results the actions taken by the suppliers will result in. In addition, the authors affirm that analyzing suppliers as dynamic systems means also that the suppliers' performance is dependent not only on current performance, but also on how current actions will affect future performance. In order to model the dynamic systems, Masella and Rangone (2000) created a framework that consists of the three variables mentioned previously; their framework can be seen below in Figure 2.

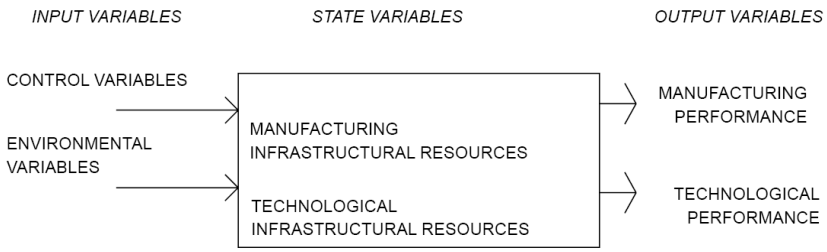

Figure 2. Dynamic systems model for supplier selection (Masella and Rangone, 2000).

The *input variables* are divided into two groups, control variables and environmental variables (Masella and Rangone, 2000). Control variables are measures that the suppliers can take in order to improve their performance, these include investments and quality improvements. The environmental variables are the ones that are not controlled by the supplier, such as market changes, competitors and consumers. These inputs are what the supplier will do, or attempt to do in order to change their product/service outcome. However, actions taken as input are not always seen by the buying company.

The *state variables* work closely with the *input variables* to determine the outcome of a supplier's actions. As it can be seen from Figure 2, the state variables are divided into manufacturing and technological infrastructural

resources. These *state variables* are a set of tangible and intangible resources owned by the company. In other words, the *state variables* are what make a supplier unique, they provide its core-competency.

The last set is the *output variables* that are basically the supplier's performance. These are also divided in two, manufacturing performance and technological performance. In a nutshell, manufacturing performance is related issues such as cost, lead times and flexibility while technological performance is more related to innovation and, obviously, technological advantages. From the three variables cited, two of them provide supplier selection criteria, *state variables* and *output variables*. According to Masella and Rangone (2000), there are four different sets of measures that can be used as criteria to assess a supplier:

- Manufacturing performance measures;
- Technological performance measures;
- Measures of manufacturing infrastructural resources; and
- Measures of technological infrastructural resources

Masella and Rangone (2000) argue that not all these measures are always necessary to choose a vendor (supplier). These can be a set of comparison tools for managers to identify and segment the most suitable partner to each type relationship and which ones are more likely to perform the best in the future (Clarke and Freytag, 2008). As mentioned previously Masella and Rangone (2000) believe that a supplier performance does not depend only on current performance, but also in the infrastructural resources that can promote a boost in future performance.

However, companies cannot select/keep suppliers based on what their future performance can be. In good supplying relationships future performance can mean improvement and better profits. However, if the relationship between buyer and supplier is poor, perhaps, there is very little the supplier can do to change that. As Wilson (1995) argues, buying company's trust in a supplier is a present state, not necessarily influenced by what can be the future outcome of the current actions. Hence, even though a supplier's performance can be seen as a dynamic system, buying companies may see them "moment by moment", which can result in the end of a supplying relationship that could be improving, or vice-versa. In addition, as the German poet Rilke says "A person isn't who they are during the last conversation you had with them - they're who they've been throughout your whole relationship". In one hand, this quote can also be applied to supply relationships and it can question the validity of the implications of future actions in poor relationships. On the other hand, in good

supplying relationships, this is an invitation to see what performance improvements the future actions can take.

2.1.4 Combined model

Using the three models introduced in the previous sections, a hybrid model was created in order to better understand the most relevant points to evaluate when selecting suppliers. Some authors mention performance and infrastructure as the most important evaluation criteria (Masella and Rangone, 2000). Other authors prefer to segment more the criteria so that the evaluation can be more thorough (Cavusgil et al., 1995; Choi and Hartley, 1995; Jonsson and Zineldin, 2003; Lin and Chen, 2008; Pryjma, 2010; Wilson, 2002). In addition, some parts of the models presented relate to the maintenance of supplying selection for maintaining relationships, and not selection of new suppliers. Therefore, this kind of criteria that aims selecting suppliers that the buying company knows already will be left out of this section. As it can be seen from Table 2, the combined model is divided into four groups, company, performance, resources and services.

Table 2. Combined model for supplier selection (based on Cavusgil et al., 1995; Choi and Hartley, 1995; Jonsson and Zineldin, 2003; Lin and Chen, 2008; Pryjma, 2010; Wilson, 2002)

Group	Criteria
Performance	Quality
	Delivery
	Price
Resources	Technical/Technological capabilities
	Manufacturing capabilities
	Financial
	Language
Services	Customer service
	After sales/ Warranty
Company	Geographical Coverage
	Reputation/Reliability
	Trust
	Flexibility

Table 2 comprises the combined version of the most relevant criteria for selecting suppliers, according to the mentioned sources. The following section will describe more about how companies end up expanding their supply base, either intentionally or not.

2.2 Requirements towards suppliers

As stated in the Strategic Review from the Emerald Group, “logistics practices have long since taught strategists that in purchasing (sourcing) it really is about much, much more than the price” (Emerald, 2005).

2.2.1 Commitment and trust

Čater and Čater (2010) made a study on product and relationship quality and their influences in customer commitments. Several authors mention how the businesses tendencies are shifting from transaction based into relationship based (Araujo et al., 1999; Čater and Čater, 2010; Wilson, 1995). When considering the B2B markets, in theory, it is possible to assume that relationships are less influenced by personal relations and emotions. However, Čater and Čater (2010) study argues that, when considering their relationship quality the “social” side prevails over the “technical” side. In other words, cooperation and trust are more important in a supplier-customer relationship than knowledge transfer and adaptation. In addition, “the quality of relationships affects how relationships develop, what the likelihood of their ending is, and what revenues, costs and profitability they incur” (Holmlund, 2008, quoted in Čater and Čater, 2010). Furthermore, Čater and Čater (2010) conclude that customer loyalty is more dependent on emotional motivation than on rational motivation. Hence, according to them, in order to maintain a good quality relationship it is necessary to have emotional commitment from the customer/supplier in order to succeed. These results imply that supplier selection, as well as supplier elimination, may be influenced by other factors than systematic choices and hard data. This affirmation must, therefore, be considered in supplier elimination processes and methods.

Wilson (1995) takes a different approach towards commitment and trust than Čater and Čater (2010). He states that commitment “is the desire to continue the relationship and to work to ensure its continuance” (Wilson, 1995). This approach seems to be closer to what is expected from the literature, B2B relations tend to be more based on technical capabilities and measurable facts. Yet, Wilson (1995) does not specify whether commitment has a bigger tendency to be evaluated from a more technical or a more social side. In addition, he states that commitment can be seen as an enduring desire to maintain a valued relationship. A valued relationship can be defended in several ways, both technical and social. Therefore the affirmation that commitment is mainly influenced by emotions is not denied by the author. Moving on to trust the definition gets even more blurry. This aspect of a relationship is crucial to development, yet highly subjective and, as Wilson (1995) argues, it is time dependent. According to the author when companies

are questioned about their trust in suppliers/partners the informants give a present state report. Hence, when a supplier manager is interrogated about the trust on the supplier, it is likely that the answer will be based on the present time. This implies that if the buying company is not satisfied with the supplier's performance, it can be eliminated based on a time-bonded biased judgment.

2.2.2 Lean sourcing

Lean production was a set of measures that appeared in the 1970s introduced by Japanese automotive manufacturers, namely Toyota (McIvor et al., 1998). With these actions the Japanese car industry started overcoming the American and European industries especially because of its final product's quality and low price. This phenomena was a global shifter towards several directions in a broad range of areas including, low inventories, pull supply chain, total quality approach, job rotations, just to name a few. Such practices were derived of cultural principles in Japan and were quickly introduced all over the country (Stevenson W. J., 2007). A great part of the success of the "Toyota Production Model" is due to sourcing, especially to working closely with suppliers.

Some principles highly important in lean sourcing are supervise your suppliers, develop supplier's technical capabilities and conduct joint improvement activities (Emerald, 2005; McIvor et al., 1998). First, supervising the supplier is basically to evaluate critically the suppliers' operations and, provide them feedback that can improve parameters such as cost, product or service, for example. Second, developing suppliers' capabilities is done in order to ensure that the supplier will, not only, attend all present requirements of the buying but also evolve together. This also means developing their ability to innovate. Third, conduct joint improvement activities is also related to the previous point. The idea is to exchange best practices between partners in the relationship to trigger the constant development of both ends of the partnership. As it can be seen, to follow the principles introduced by lean manufacturing, it is required to have a manageable supplier base. Otherwise, it is very difficult to be aware of the just mentioned practices in all key suppliers for the company.

As the Japanese principles started appearing, companies started seeing the benefits of the Total Quality Management (TQM) approach, and the benefits of keeping low inventories to reduce cost (Emerald, 2005). This tendency shifted several key points in sourcing/purchasing. Previous to the "Toyota revolution" companies focused on prices and were motivated to increase their supply base in order to compete suppliers against each other (Wilson, 1995).

However, the Toyota model proved possible to maintain costs down, by applying TQM to reduce costs such as inventory and transactions. The result seen was that companies could focus more on partnerships with their suppliers in order to maintain the optimal relationship to reduce costs on both ends resulting in win-win situations. The trend seen from those days until nowadays is of replacing the tough negotiation game by a more constructive and deep relationship with suppliers (Emerald, 2005).

Yet, relationships have to be closely checked and long-term partners cannot get a too comfortable position, what can jeopardize the entire partnership. As Anderson and Jap (2005) say, partners grow increasingly dissatisfied as relationships continue. To conclude, the lean manufacturing system has added several important concepts to different areas in companies. Sourcing was one of the areas where major improvements were seen and concepts such as low inventory, just-in-time and total quality management became reality in many industries. The implementation of these concepts resulted in a long-term focus with a smaller amount of partners. Nevertheless, these concepts also mention having more than just one supplier per category to have a viable option and negotiation power (Anderson and Jap, 2005). The following section will describe some supply positioning methods used in sourcing.

2.3 Supplier base expansion

There are several manners of expanding a company's supplier base, some forms are intentional and some of them are consequences of other management decisions. Nevertheless, literature shows that basically two of them are the most relevant for business currently:

- Guaranteeing competitiveness among suppliers
- Mergers and acquisitions

Ogden and Carter (2008) argue that during the past several decades a method of guaranteeing lower price was based on competition. This is also called the adversarial model, which basically means having a larger supply base so that the company could put its suppliers in competition in order to achieve the best possible price (Wilson, 1995). Obviously, this resulted in a supplier base expansion, once each type of sourced material would have to have a many suppliers that could compete against each other. Currently, there has been a shift in this trend and it is argued that the optimal supplier base is composed of a few partners, which work closely with the sourcing company (Shin *et al.,* 2000; Wilson, 1995). This is also called a cooperative model,

where both parties aim to achieve lower costs by working together trying to reduce their operating costs.

Another business practice that results in supplier base expansion is mergers and acquisitions. Since the early 1970s, companies were encouraged to diversify their activities through mergers and acquisitions (M&A) (Davidson, 1981). This trend has several reasons, such as becoming better opportunities for investments, better allocation of capital and reduced risk by acting in diverse industries. According to Hise (1991), other reasons for acquisitions include getting undervalued assets, gaining synergy, building shareholder value, maintaining competitiveness, growth and achieving a dominant size. When companies merge or are acquired, they do not change automatically to match the new company culture or supplier base policy. At least for some time, these companies continue operating with the same employees, suppliers and customers. However, this practice tends to create an overlapping supplier base in the new company, as illustrated by Figure 3.

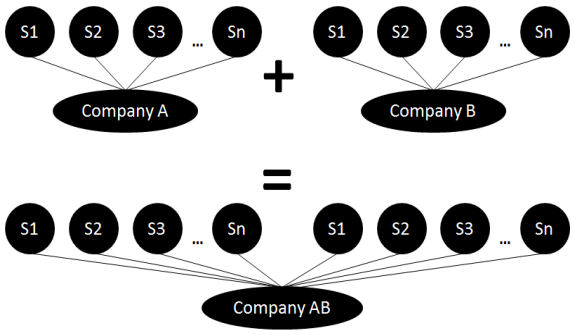

Figure 3. Effect of M&A on the supplier base.

As it can be seen, the supply base can increase significantly. However, there are several more urgent problems to be solved than rationalizing the supplier base, such as creating a synergy between the companies, unifying databases and systems, and merging the way of working. In addition, without proper management, M&A can, for example, become unresponsive to opportunities and trends and unnecessarily bureaucratic (Curwen, 2005). Even if the relevance of the supplier base reduction is not seen at first, a big portfolio can incur in extra indirect costs, which are not always seen by the management, resulting in a waste of resources. Moreover, Tan *et al.* (1998) discovered that almost 40% of their respondents did not track the total number of suppliers used. This number shows how significant a process such as supplier base reduction can be in 40% of companies. Also, by controlling tightly the amount of suppliers, manufacturers can benefit from partnering with their supplier for common cost reduction issues, for example. The following section continues

to tackle the supplier base expansion issues, but this time on how to reduce a supplier base.

2.4 Supplier relationship management

In order to be able to follow the market changes over the past decades companies have developed many methods of handling the supply chain and suppliers. As the transaction based relationship is more and more rare, other types of relationship appear and management techniques for these. Even though transaction based relationships are not so common anymore, they still are necessary, depending on the type of product and company strategy. Therefore, companies have to be able manage different types of suppliers that have more or less importance. In order to cover the different types of supplier relations different frameworks and working models have been developed. The following sections will present supply positioning methods, as well as different interfaces to position and manage supplier relations.

2.4.1 Supply positioning

There are basically two types of supplier relations, the adversarial and the cooperational model (Wilson, 1995). In a nutshell, with the adversarial model the suppliers face each other, the one that offers the lowest bid is used. On the cooperative model, lower costs are achieved by working together in reducing both buying and selling company's operative costs. However, to determine which suppliers can be used in the adversarial mode or the cooperational one can be complicated. Wilson (1995) developed a framework to evaluate and consequently position suppliers to have a better understanding which ones have potential do become partners, and which ones do not. The framework developed is a 2x2 matrix whose horizontal axis represents the amount of value added by a supplier to the business, while the vertical shows the operating risk associated to the supplying relationship. This framework can be seen in Figure 4 below:

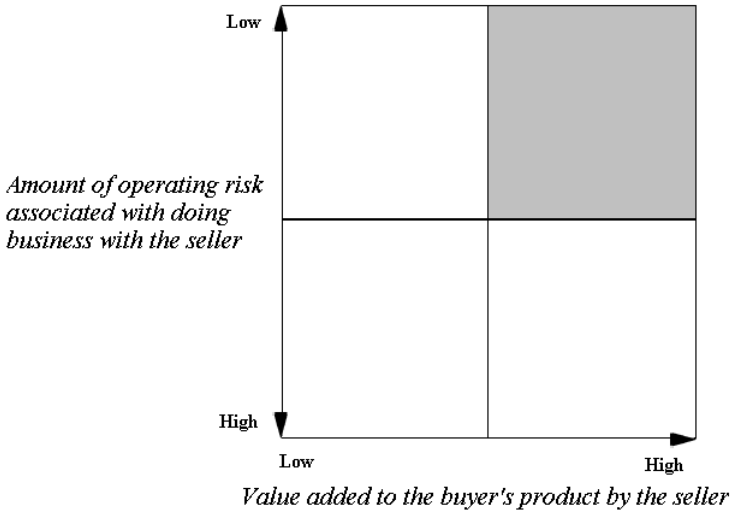

Figure 4. Classifying potential partners (Wilson, 1995).

The operating risks posed by the supplier include, but are not limited to, low quality components and delayed deliveries. This dimension can also be called supply risk. The higher the risk is, the less likely it is that such supplier will become a partner and the more problematic relations can be. Issues considering this matter include difficulty to find the components in the market, complexity of switching suppliers and the business impact in case the component is not acquired successfully. The market difficulty, for example, does not only include components that are difficult to produce or produced by a single source. Market difficulty can come out of natural disasters such as the tsunami in Japan in March 2011, that basically stopped the Japanese industry and impacted industries globally. The business impact caused by suppliers is on components that are irreplaceable by other sources, or then components that can stop the production line in case these are not available. Obviously, high risk suppliers are better avoided, but as this is not always possible, companies have to allocate an extensive amount of resources on higher risk suppliers in order to avoid complicated situations, such as supply shortage.

On the other axis, the value added by a supplier can be special services, longer payment period, and specially designed products, among others. In other words, low value added would be a standard offering without tailored settings, while a high value added implies on commitment made by the supplier to a long-term relationship. Another, and more objective way, form of evaluating the value added by a product is to use its acquisition price (Wilson, 1995). This method starts with the assumption that higher costs imply in more complex products, therefore, generating higher value added. The acquisition price can be evaluated based on single components or on the annual amount of money spent with a supplier.

However, it must be noted that both dimensions represented on Wilson's (1995) framework are subjective and dependent on interpretation by the personnel of the buying company. Therefore, when placing suppliers in the matrix presented, it would be preferable to have a team working on the evaluation of these suppliers, risks and value added. The following section will describe more about how the supplier-buyer relations between companies can be. In other words, depending on the type and complexity of a product, how a supplier should be managed in order to reduce the risk and increase the benefits of a partnership.

2.4.2 Supplier interfaces

Each different type of supplier requires different management methods. Some suppliers require constant contact, visits and negotiations, while others are seen once a year or even less. In general, suppliers that require constant attention provide either great volumes or components/services of great importance, as for suppliers that are rarely seen may supply commodities, for example. Araujo et al. (1999) present a model to manage supplying relations that classify suppliers according to the amount of information exchanged between buyer and supplier. This model is divided in four groups:

- Standardized interfaces,
- Specified interfaces,
- Translation interfaces, and
- Interactive interfaces

Standardized interfaces are the ones related to components that are largely influenced by the supply-demand situation in the market (Araujo et al., 1999). In this management method the connection between customer and supplier is minimal and of some sort of generic nature. Low investments are required and these types of components tend to be widely available. Hence, switching costs are low and little effort is required to obtain components like this. One example of components that is handled by this interface is commodities.

Specified interfaces involve parts that are made on demand, but still nothing that requires heavy R&D or complicated specifications (Araujo et al., 1999). Examples of these parts are bushings and seals. In order to manufacture these components some specifications are needed by the customer, but it still is a routine job for the supplying company. However, this interface implies in higher part costs and relationship costs. The reason is that is not always possible to optimize the material usage, which results in more waste. These results in locked resources and the supplying companies have to tie-up to the

buying company. Therefore, in this type of relationship a longer term vision is required and switching costs increase.

Translation interfaces are used when the buying company specifies the technical specifications such as physical shape and mechanical strength and the supplier has the freedom of fine tuning those into a product (Araujo et al., 1999). Basically, in this type of relation, the buying company has a stronger relation with the supplier once they outsource the R&D development and testing to the supplier. More trust from the buyer and more commitment from the supplier are required to maintain this type of interface (Čater and Čater, 2010). This type of relation is more beneficial for the supplier once it can run its production line more freely and it can result in reduced waste, for example. Moreover, the supplier can combine orders from different clients in order to maintain an optimal production line.

Interactive interfaces exist when there is a common effort from the buying and the supplying company to develop the products (Araujo et al., 1999). With this type of interface there is a lot of negotiation involved. The supplier typically wants to standardize as much as possible the product to resemble its own already existent products. The buyer typically wants to have the best quality with the lower price (Svensson, 2004). Due to the cooperational aspect of this type of relationship the two parts tend to find common ground and to establish an acceptable product for both sides.

These four interfaces are different methods of interacting with suppliers from a buyer's perspective. In order to determine the most likely scenario of usage for each type of interface, the following section will combine the interface model just presented with the positioning model presented in the previous section. The combined model is an attempt of determining, based on supply risk and value added by the supplier, what is the most suitable interface to be used.

2.4.3 Combining the positioning with interfaces

In order to have a full model to manage supplier relationships, and to understand what the implications in a supplier base reduction process are, a combined model was created. The model created by Wilson (1995) is used as a base to determine supply risk. With that done it is possible to classify the suppliers according to most to least risky. Moreover, it is easier to target sources for a pilot study in supplier base reduction. However, solely targeting the suppliers is not enough to successfully eliminate them from the supplier base. In order to fulfill such gap the model presented by Araujo et al. (1999) will be combined with the supply positioning model presented by Wilson (1995) in order to have a better understanding on how to interact with

suppliers to be eliminated. The combined model can be seen in the Figure 5, below:

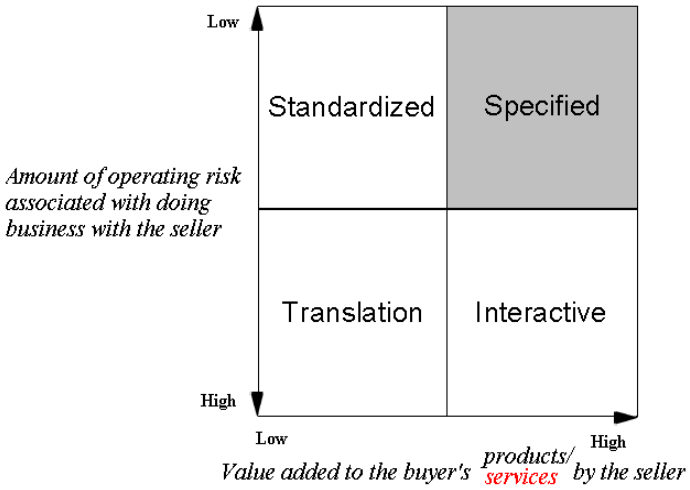

Figure 5. Combined model for supplier positioning and interface (based on Wilson, 1995 and Araujo et al., 1999)

The combined model presented above can give several insights to all sorts of processes involving supplier relations. For example, it is known that, in general, low risk-low value added suppliers provide commodities or very standard components. However, when checking the combined model presented account managers can have a more straight-forward approach towards the communication. Obviously, not all suppliers in each category will fall under the determined description, but this generalization is possible. A little change was made in the horizontal axis to comprise more types of suppliers, the word services was added next to products. The reason for that is that some suppliers' services also add value to the customers' services, such as packaging and delivery, for example.

For the supply base reduction process, basically two lessons can be taken from this model. First is to watch the line that divides the left side from the right side. Second, is to evaluate if the interface presented by Araujo et al. (1999) is in real life as mentioned in the article.

First, knowing that the project which this thesis is created for is to start the development of a supplier base reduction process, the less risk involved in the project the better. Hence, this project would only use the higher part of the matrix, the boxes named standardized and specified. It is a curious process to determine the relevance of the distinction between standardized and specified, and where to make a distinction. There can be a hard distinction between the two boxes, for example the annual spent on the supplier. However, that does not necessarily evaluate the value added by products or services. Yet, this is

an interesting point to be observed while executing the supplier reduction project.

Second, the interfaces described by Araujo et al. (1999) seem to be interesting approximations towards supplier/customer management. However, it will be interesting to see if when reducing the number of suppliers the replacement suppliers will have a similar interface to the previous one or not. In addition, Wilson (1995) highlights the top right box of the matrix to show that the ideal for companies is to have the biggest amount of suppliers there. Hence, one challenge will be to see how difficult it is to replace a standardized supplier by a specified one, for example.

The previous sections introduced some concepts in supplier relationship management. The first section went briefly into supplier positioning in order to identify the biggest risk/reward potentials and where to focus the most amounts of resources. The second section provided an insight into which kinds of interfaces are used when different types of products are bought. This showed the difference between buying standard items vs. buying more tailored items. Finally the third section combined the two models presented into one containing all the variables of both. The idea behind combining these models is to understand better the implications in relationship management when targeting suppliers for elimination. As this project aims to focus on low risk suppliers the discussions were basically made considering the two boxes on low risk side. The following section will describe the most relevant criteria, based on the studied literature, to reduce the number of suppliers.

2.5 Forms of reducing the supply base

In order to rationalize a company's supplier base, Ogden and Carter (2008) argue that there are three main approaches, systematic elimination, standardization and tiering. As mentioned previously, there is a lack of literature in the specific topic of supply base reduction (Ogden and Carter, 2008). Therefore, the study made by Ogden and Carter (2008) is the main lead towards a standardized approach in such topic. Nevertheless, some other authors were used to compile the final four forms of reducing the supplier base. Other authors add a fourth method for decreasing the size of a supplier portfolio called bundling. These are all described in more detail in the following sections.

2.5.1 Systematic Elimination

Systematic elimination consists of defined methods and criteria that, once applied to the supplier base, distinguish suppliers to be kept from the ones to be eliminated. Nevertheless, this method can have different approaches that vary from simpler methods to more strategic ones. Suppliers can be invited to competitively bid for a contract or purpose (Ogden and Carter, 2008). This method can be very useful on supplier bases that kept several options for the same component categories in order to have a more competitive price. However, a few considerations must be taken into account in order to avoid supply risks. Companies should keep back up options for suppliers that provide components that can provoke a high impact in the business, or that are positioned in a difficult market or where there is high complexity of switching (Ferrin and Plank, 2002).

A second option for using systematic elimination is developing a method to reduce the number of suppliers. For this option, it would be ideal to have a main preferred supplier in each category of purchased items. This way, all the components supplied by other suppliers would fall under the main one's jurisdiction. However, this is only the beginning of the process. The most complicated part of this approach is to develop a method to target the correct suppliers to be eliminated. Once the method is developed, having a systematic approach has the advantages of being standard and, with the correct management support it is easier to remove the emotional side of the supplier relationship. The emotional side, as it will be mentioned in section 3.1.1, is the main factor for generating trust in a supply relationship. Hence, by coldly analyzing the whole supplier base with the right management support this process has more chances of succeeding (Ferrin and Plank, 2002). In general, this is the most recommend form for reducing the supplier base it actually cuts the relationship with suppliers and it is systematic.

2.5.2 Standardization

Standardization is a more complex approach that involves more other departments than sourcing. Basically, this method involves redesigning processes or parts in order to increase the usage of the same components (Ogden and Carter 2008; Holweg, 2005). For example, if a company produces wheels, and for the wheels produced the company has one type of bearing on the inner side and a different type for the outer side, and each bearing is supplied by a different supplier, the standardization method would require a redesign of such wheel to make it possible to use the same bearing, both in the inner and outer side. With this method companies can gain negotiation power due to an increased number of parts bought from a single supplier and

lower supply risk along with inventory costs, just to name a few advantages. Nonetheless, this is a very long process that requires a great deal of support from top management to make all departments cooperate together.

Another method for standardization is called modularization (Howard and Squire, 2007). However, if standardizing commercial parts can be a long process, modularization is even longer. In modularization, sub-assemblies are designed to all fit together, and a whole product is a combination of sub-assemblies. This is a common practice in the automotive industry where, nowadays, the automotive manufacturers are basically assemblers (Anderson and Jap, 2005). Nonetheless, in order to achieve supplier base reduction with modularization, a common effort among several departments is required, especially between R&D and sourcing.

2.5.3 Tiering

Tiering is not exactly a supplier base reduction method, but it can be considered a supplier outsourcing method. In other words, tiering is moving first tier suppliers to second tier suppliers, as shown in Figure 6 (Oh and Rhee, 2010). Figure 6a shows the initial state of the enterprise, while Figure 6b shows the result of tiering. The benefits of this method are that the company handles fewer suppliers, while its suppliers handle a few others (Ogden and Carter 2008). By doing this, the company 'outsources' its supplier management, usually by paying for this service.

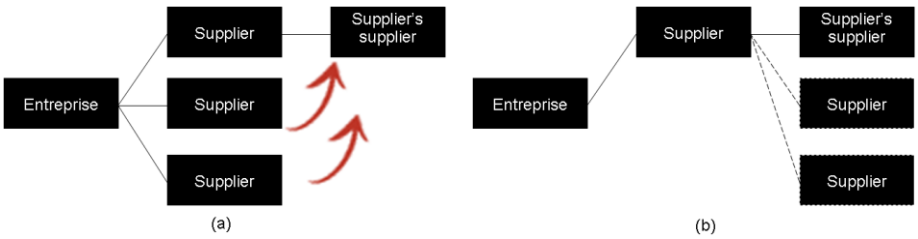

Figure 6. Example of tiering (modified from Holweg, 2005).

This way the amount of suppliers in the whole supply chain does not change. However, with this system all companies, including suppliers, finish with a manageable supply base. Again, the automotive industry is an example of tiering. When modularizing the systems in the automobiles, car companies started buying the whole assembly from their first tier suppliers, leaving small parts to be handled by them. Therefore, there are several methods for tiering suppliers, but no matter which process it is the goal is always the same.

2.5.4 Bundling

A fourth method of reducing the number of suppliers is called bundling (Oh and Rhee, 2010). *Bundling*, as shown in Figure 7, is putting suppliers to cooperate together, and handle them as one entity. This kind of approach can be done by using suppliers to buy sub-assemblies instead of individual parts, for example. However, this can be a complicated process once the suppliers have to cooperate together so that this system would work. Considering this as supplier base reduction is not necessarily correct, once the amount of suppliers remain the same, only handled in a different way. Yet, it can be a useful approach once it is notorious that having less interfaces to handle can be clearly seen as an advantage.

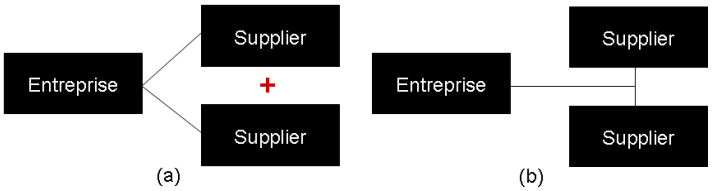

Figure 7. Example of bundling.

To summarize, the four main methods seen in supplier reduction processes are systematic elimination, standardization, tiering and bundling. From these four methods, systematic elimination and standardization are methods that actually reduce the amount of suppliers, while tiering and bundling only reduce the amount of suppliers handled.

Standardization was left out from this study due to its complexity and high dependence on many stakeholders. The preferred method for the present study is, then, systematic elimination, once this is basically the only short-term possibility for actually reducing the number of suppliers. Nevertheless, bundling and tiering will also be used as a second option for suppliers that prove to be complicated to substitute.

2.6 Supplier base reduction criteria

In their research, Ogden and Carter (2008) discovered that companies can use more approaches on supplier base reduction, however, one of them is always more prevailing than the others. In the case of the companies studied the systematic elimination was the majority's choice (Ogden and Carter 2008). Yet, the study made by them does not focus on the process used to target the suppliers, it mentions that the companies used information available internally.

Further discussions suggest that visits and requests for proposals are required, but no details are given.

As it was mentioned previously, it is difficult to find literature in supplier reduction process and criteria. Therefore, another way of approaching supplier base classification and reduction was taken. The literature analysis was made based on supplier selection. Interestingly, the criteria used to select can also be applied to eliminate a supplier. Clarke and Freytag (2008) argue that one criterion to select suppliers is the value they add to the buying company. This involves more than components, sub-assemblies or complete assemblies, it involves partnerships and services provided. In addition, they mention that geographic location plays a very important role in supplier selection.

When regarding the buyer-seller relationship, Wilson (1995) presents a set of criteria that can be used to evaluate the relation as well as the possibility of its continuity. Following a complete study in the literature combined with empirical support, Wilson (1995) compiles a list of the most suitable variables to be analyzed in a buyer-seller relationship. The extended list is:

- Commitment
- Trust
- Cooperation
- Mutual Goals
- Interdependence/Power Imbalance
- Performance Satisfaction
- Comparison Level of the Alternative
- Adaptation
- Non-Retrievable Investments
- Shared Technology
- Summative Constructs
- Structural Bonds
- Social Bonds

This list determines the topics that, once considered and evaluated tend to keep a good relationship between buyer-seller companies. However, when considering the termination of the supplying relationship some items are difficult to evaluate or too subjective to create a standard process. Hence, some of the items described will be combined and some of them will not be used in order to achieve a more compact and descriptive process. First, the items commitment, trust, cooperation and social bond will be considered under reliability. The term was chosen in the attempt of being descriptive enough and easily understood. Yet, this is a very subjective criterion especially when regarding the social bond, some buyers may be biased to trust a supplier due to a good relationship. Second, adaptation, shared technology and structural bonds will be considered as value added by the suppliers. Third, performance

satisfaction will remain as one criterion for evaluation. The remaining criteria presented by Wilson (1995) will not be added as part of the evaluation in order to reduce the number of suppliers.

Svensson (2004) takes a more classical approach to supplier selection, once his study is related to the automotive industry. The three most relevant factors to this study are annual spent, delivery service and product performance. These factors are easily accessible within SMC databases and also relevant to supplier base reduction. Also, based on the supplier selection section introduced previously in this thesis, a shortlist of criteria was drawn. From all these criteria, a few were recombined to fit a compact model to facilitate the process of targeting suppliers for elimination. Resources are divided between supplier/product performance and value added. Services are combined with value added by the supplier, including all sorts of extra services provided. The market bundle has one independent item, geographic coverage, while reputation and trust are combined under reliability. Combining the factors presented by Clarke and Freytag, Ogden and Carter, Pryjma, Svensson and Wilson, Table 3 was elaborated.

Table 3. Supplier reduction criteria combining different sources.

Criteria	Clarke and Freytag	Ogden and Carter	Pryjma	Svensson	Wilson
Annual spent				**x**	
Delivery service				**x**	
Information available internally	**x**	**x**			
Geographic location	**x**				
Supplier/Product Performance			**x**	**x**	**x**
Request for quotations (RfQ)		**x**			
Reliability			**x**		
Value added by supplier (services, adaptation, after-sales, technology)	**x**	**x**	**x**		**x**

As it can be seen, by combining different sources it is possible to compile a list of the most relevant, yet achievable criteria on supplier selection that can be

applied to supplier elimination process. This list was used as the starting point for creating the framework for supplier base reduction. The interviewees were presented with this list and based on their answers and information available in the ERP systems a final framework was developed.

2.7 Chapter synthesis

This chapter introduced a literature review on topics relevant to supplier base management. The first issue tackled was supplier selection, three models for selection were introduced and a combined model was formed based on them all. This combined model was a divided into four main groups, performance, resources, services and company. These four groups had its own subdivisions and included criteria to be expected such as, quality, price, warranty services, and technical capabilities. However, it also brought up criteria that were new to the researcher such as reputation and trust, as well as delivery systems evaluation.

The second section presented some requirements towards suppliers and the first topic was commitment and trust. Regarding the first topic, it was shown that commitment is more influenced by emotional motivation than by rational motivations. This particular finding shows that when attempting to create a process to eliminate suppliers, some emphasis must be taken to evaluate the process subjectively. Also, when considering trust it was found that it tends to be an evaluation of the present state of the relationship, giving little emphasis to past or future. The second topic presented in this section was lean sourcing. The main conclusions to be drawn from lean sourcing are the close cooperation and supervision are required to be able to apply these successful principles into practice. However, in order to do that, two things are necessary, a manageable amount of suppliers and constant management.

The third section is a fairly short section that showed two methods for expanding the supplier base, purposefully and through mergers and acquisitions. The purposeful expansion idea is to increase the competition among suppliers to have more options in case of delays, as well as having a constant bidding process to have lower prices. The M&A method is basically a consequence of having a company added to a branch. Acquired companies are done so while working, hence, an operating supply base is a mere consequence.

The fourth section introduced two frameworks, one for supplier positioning and the second for interface management between buyer and seller. The supplier positioning model is a 2x2 matrix that relates the operating risk with the value added by the supplier. This model gives a four box option to position a

supplier and analyze risk and management approach. The supplier interface management model introduced four approaches that can be taken when administrating a supply relationship. By combining these two models, it was possible to have a model that would relate the amount of risk involved in a supply relationship and the type of management required in each of the four boxes.

The fifth section presented forms of reducing the supplier base. Four forms were shown, systematic elimination, standardization, tiering and bundling. From these two are used in reducing the supplier base, while the other two are used in reducing the amount of interfaces managed. It was determined that for the current study systematic elimination is preferred, but tiering and bundling would also be used. Finally, the last section combined models to establish the most relevant criteria to be used when targeting suppliers to be eliminated. Eight criteria were chosen, and the combination of these is the starting point of creation of the framework for reducing the supplier base. The following chapter will drill into the research methodologies used in this project. Also, data gathering methods, framework and process development, as well as the implementation process will be presented.

3 RESEARCH METHODOLOGY

This study was essentially done in two parts. The first part was a research performed as part of the course Academic Writing and Research Methodologies II. This first period consisted of an initial study phase of the company, its working environment and IT systems. During this period interviews were performed in order to develop a framework to reduce the number of suppliers in the Vehicle and Mechanical Components category for the Tampere site of SMC. Once this project was over and the goal was achieved the second period started.

For the second part of the research a four step process was developed along with a flowchart to be followed while reducing the number of suppliers for SMC. Moreover, the scope of the project was changed, from the Tampere site to the Logistics division of the company. In order to detail the research process this chapter was divided into four sections, first the data gathering methods. Second, the framework research process, where the steps are outlined and a timeline are presented. The third section explains how the framework was developed. The fourth section explains the four steps in the reduction process along with the flowchart developed, as well as it elaborates on the “testing” phase, which consisted on the researcher performing the reduction process himself across the Logistics division on a global scale.

3.1 Data gathering methods

For the completion of this paper three methods have been used more intensely: existing material, qualitative interviews and action science. Analyzing the existent material is necessary in order to have a basic understanding of the case’s background and to search for similar cases studied previously. Qualitative interview is a method that requires certain preparation and interaction with workers on different hierarchical levels and positions. A description of all the people interviewed in SMC is given in the following section. Finally, action science was conducted during twelve months working as a student researcher in SMC Tampere visiting the company once a week during the first semester and daily during the second semester.

Gathering data for the study is the first step taken in the research. In this part, it is necessary to determine which approach to take, that can be either a qualitative or a quantitative approach on the scientific paradigm (Gummenson, 1993). On one hand, taking the qualitative approach, the researcher does not have clear procedures and the results may be influenced by his/her opinions. On the other hand, when approaching research from a qualitative side, the

study is more systematic and the results are less biased, at least theoretically. However, case studies can have a hybrid research method that combines the qualitative and quantitative approaches to get a better perspective in the study. For the purpose of this study, the qualitative approach is often the most accessible one, as collecting hard data requires standardizations and is often difficult to keep a realistic enough approach. Also, according to Čater and Čater (2010) supplier relations tend to be affected by the emotional side of supplier managers, which tends to lead the research to take a qualitative approach rather than quantitative. In addition, the research is based on people's opinion about the matter, hence, a bigger tendency towards the qualitative approach is more convenient.

In the data gathering process there are several options that can be used by a researcher, one of them using existing material. This method is useful and it is the most common one. However, this method should be used carefully and trustworthy sources have to be used in order to get a high-quality study. A second option for data gathering is a questionnaire survey, which is usually related to quantitative methods (Gummenson, 1993). However, this method can also be related to more qualitative approaches based on the type of questions proposed. This is a useful approach, but to enjoy all the advantages the right people have to be questioned in the survey. In addition, the researcher has to prepare a systematic way to present to the respondents, in order to avoid getting biased results.

Another method introduced by Gummenson (1993) is action science in which is the researcher takes part in the process studied. In action science the researcher performs the work that will serve the research purpose. This work can be, for example, a practical experience in a case company, or executing tasks to achieve a certain goal. In addition, this method tends to be very effective in research as reality is much more approachable this way. However, it is a very time consuming method and requires a lot of cooperation from the participants.

3.2 Framework research process

The main process used during this study was action science, developed weekly over a period of six months *in loco*, in Sandvik Mining and Construction (SMC), Tampere. This paper is built on the problems faced by SMC and its increased number of suppliers, which results in several indirect costs that could be avoided. In parallel with the supplier reduction process, interviews were conducted with several employees at SMC in order to get a better perspective on the issue from different points of view. The intervewees were

selected based on their functions towards sourcing. The key issue was to have people from different areas to have divergent opinions towards the matter. Therefore, sourcing professionals were used from the different hierarchical levels (Global Sourcing Project Manager, Site Sourcing Manager, European Team Leader of Global Sourcing and Global Sourcing Category Manager). Also, from a more operative side, there were interviewees that were directly related to the production area (Operative Purchasing Manager, Purchasing Engineer and Global Head of Production). This selection was determined to be inclusive towards the main stakeholders that are related to supplier relations.

Once the interviewees were defined, the interviews were scheduled and the agenda was determined. Such interviews were meetings where a few key points were in the agenda, but basically they flowed as free discussions. By doing so, the discussions took very interesting perspectives that would not have been achieved in formal interviews. A timeline is shown in Figure 8.

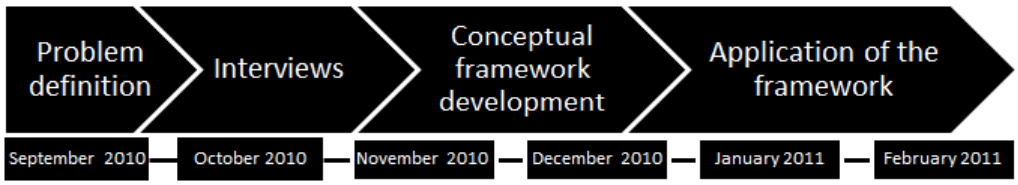

Figure 8. Research Process of the Study.

As illustrated by Figure 8, the first research process took place in four different phases. First, there was a problem definition phase which, in other words, was getting a full understanding of the company's situation and determining the study's goal. In addition it was possible to get familiar with the practicalities of the work and the reality in SMC. Second, people from different departments were interviewed so that a conceptual framework based on their opinions could be developed. The details of the interviewees and the interview dates are shown in Table 4.

Table 4. Interviewees and dates of interviews.

Employee's title	Date
Global Sourcing Project Manager	04.10.2010
Operative Purchasing Manager	11.10.2010
Purchasing Engineer	11.10.2010
Site Sourcing Manager	18.10.2010
European Team Leader of Global Sourcing	25.10.2010
Global Head of Production	25.10.2010

Third, a conceptual framework was developed in order to make the supplier reduction process more systematic and standardized. Finally, the application of the method developed was the longest period. This was due to several factors such as, low priority regarding the project to other stakeholders and too many tasks due to the growth experienced by the company.

3.3 Development of the framework

Combining three sources of information it was possible to develop a conceptual framework for supplier classification. These three sources were SMC ERP systems, literature review and interviews. First, *the ERP system* analysis was crucial to develop any tool, as the information available in such systems is the most accurate. Certainly, there are several ways of filtering, combining and interpreting the information available. However, the most important detail of this analysis is that the result must be repeatable by others and easily done. In addition, the ERP systems were also a limitation to the study, once it was the sole database that could be explored in order to analyze the supply base. Hence, the creation of the framework was limited by the amount of available information by such system.

Second, *a literature review* performed resulted in interesting approaches taken previously by researches when studying supply bases. For example, Ogden and Carter (2008) made it clear that there is not much literature in this subject. Their research also showed that other companies approach supplier base reduction by involving different areas using cross functional teams. Even if the whole extent of Ogden and Carter's (2008) approach was not possible, employees from different areas were interviewed in the attempt of making this framework as universal as possible. Also, the literature brought some interesting concepts from the indirect costs point of view, allowing this study to broaden up the sourcing approach (Avery, 1999; Degraeve and Roohooft, 1999; Ferrin and Plank, 2002). In addition, the literature helped explaining the reasons for the current situation in SMC and the implications of acquisitions in the business reality.

Third, *the interviews* performed played a crucial role in the development of the framework for reducing suppliers. Each interview resulted in a different contribution to the framework. The interviewees were presented with the current state of development, at each stage, and asked whether they would add or remove any criteria to have a better classification of the supplier base.

3.4 Process development and implementation

The goal of this project was to make a process as simple as possible, but not too simple that would not be useful for the company. During the first phase of this study (for the course Academic Writing and Research Methodologies II), the researcher familiarized himself with the routines of the company and its sourcing practices. Then, it was possible to understand better the steps related to a supply base reduction process. Initially the idea was to classify all the suppliers and make the information available throughout the company databases, so that anybody could have access to such and, therefore, be able to target suppliers for elimination. However, in order to be able to apply the criteria to all suppliers and publish in the company databases it is necessary to test the effectiveness of the work proposed. Hence, before making radical changes, a four-step model was developed to analyze, classify, replace and finalize the eliminations in order to verify the process. The full scale implementation is dependent on the success of this trial period.

3.4.1 Process development

Once the “big picture” of the project was determined, the initial four steps, a more detailed process was required in order to standardize more the project. Therefore, together with my supervisor, a flowchart was developed in order to provide a more detailed approach to the process. This process was designed and improved before it was presented to other employees in SMC. Once finalized, the flowchart was studied by both of us and approved. Then, in a meeting the process was presented to a site sourcing manager and to a global category manager to gather feedback and get approval for the process. The feedback received was positive and the process was considered ready to be implemented. As it can be seen from Figure 9 below, the four phases of the project are placed in a timeline. The difference, however, is that Figure 9 shows the subsequent six months of the project whose first phase was finalized in the end of February.

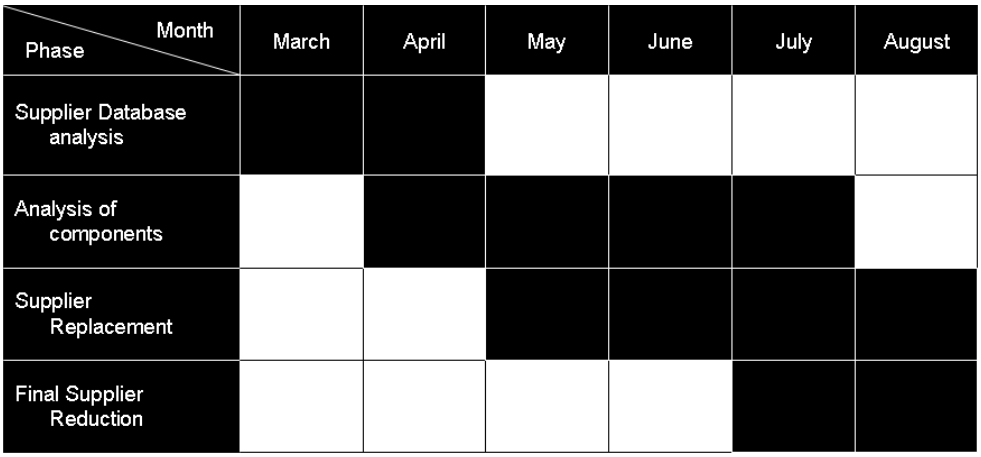

Figure 9. Development and execution phases of the project

The difference between the initial development shown in section 3.2 and the second part of the project is that several phases of the project were executed simultaneously. Therefore, Figure 9 represents which tasks were developed in each month of the master thesis work.

3.4.2 Implementation process

During the implementation phase of the work the project was handled to the researcher to manage and execute. *The starting phase* involved heavy analysis of suppliers categorized in SMC ERP systems. During this analysis period, the suppliers were evaluated according to the criteria established and the suppliers were targeted for elimination. Then, as a *transition phase*, specialists were consulted to approve or reject the supplier shortlist. Once the shortlist in each sub-category was approved it was possible to proceed with *component analysis*, which included but was not limited to technical specifications gathering, collection of technical drawings and pre-screening for possible substitutes. The *supplier replacement* phase consisted of sending requests for quotations (RfQ), price discussions, among other tasks. Basically, the third phase was executed by other SMC employees that had contact with the suppliers and authority to substitute one supplier by another. *The final stage* consisted of assuring that the components were purchased from the new assigned supplier, that the previous account was closed and that the performance of the new supplier was adequate.

4 CASE COMPANY

4.1 Sandvik AB and SMC

Sandvik AB is an engineering group that counts on unique expertise in materials technology and extreme attention to customer wants and needs. Its main goal as a company is to improve customers' profitability. The company's history dates back to the second half of the 19th century, when it was only a steel company. Currently, Sandvik AB is facing a major growth phase, which can be seen by the nearly doubled sales between the years 2005 and 2010. The company has three main divisions: Tooling, Mining and Construction and Materials Technology.

The Tooling business focuses mainly on tools and tooling systems for metalworking applications and the main customers are the automotive and aerospace industries. The Mining and Construction business core competency is rock-working equipment and tools used in civil engineering and mining industries. Finally, the Materials Technology division develops special alloys, stainless steel and resistance heating materials and the customers range from the automotive to the medical equipment industry. In 2010 the Group had 47,000 employees, sales of approximately 8 billion Euros and presence in more than 130 countries. To achieve this impressive size and presence in the world the company counted both on organic growth and M&A. (Sandvik, 2011)

In order to maintain the leading position the group invests heavily in R&D, 3% of the total sales revenue is directed to these departments, approximately 300 million Euros every year. A result of such high investments and focus can be seen by the amount of employees and active patents held by the company, respectively more than 2.400 and more than 5.000. This kind of investment has given Sandvik an increased image of an advanced knowledge company. An example is the Group's IT development of the company, high investments are being made to enhance customer benefits, improve productivity and strengthen profitability. (Sandvik, 2011)

The Mining and Construction division is the largest one in the company with over 15.000 employees, more than 30% of the total workforce. Such a high investment in human resources does not come without a big contribution to the Group's finances, in 2010 SMC was responsible for more than 40% of the Group's sales. In order to achieve such significance in the Group's activities SMC went through an intensive consolidation process where more than 20 companies were acquired and incorporated into the division. This intensive consolidation phase resulted in obvious advantages, such as global presence,

higher sales and broad product offering. Nevertheless, negative sides can also be seen in the company, a few examples are: lack of a common corporate culture, overlapping suppliers and partners and difficult administration. A more detailed description of the consolidation phase is presented in the following section.

4.2 SMC Consolidation process

The mining and construction division of the company officially started with the completion of the merger of two companies that was finalized in 1998. The companies were Tamrock and Sandvik Rock Tools. Sandvik AB had been a major Tamrock shareholder since the year of 1989, but it was not until the end of 1997 that Sandvik had practically full ownership of the company. In its 13 years of history Sandvik Mining and Construction became one of the world leaders in the production of mining and construction equipment (Sandvik, 2011).

As the Sandvik group had already experience in mergers and acquisitions from the 1970s, the mining and construction division managed to successfully target and acquire several companies. As it can be seen in Figure 10, in the 21st century SMC invested heavily in M&A, which resulted in a very diversified and bulky company. The acquisition of more than 20 companies worldwide also diversified and created a large supplier base. In addition, as a positive consequence of the acquisitions, the company got a vast presence in the globe that covers all the continents.

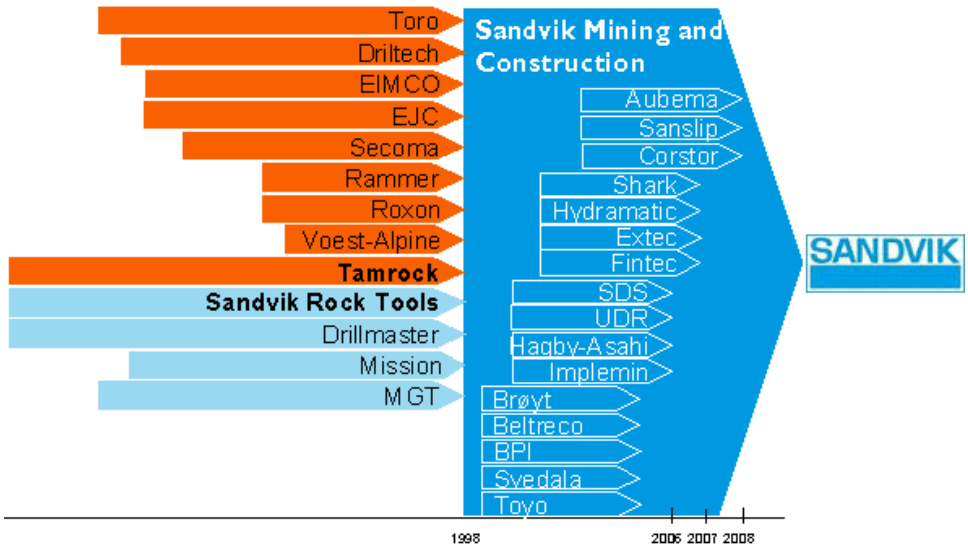

Figure 10. SMC main acquisitions.

On the other hand, mergers are very demanding processes that can impact several areas in an organization. The most known effect are IT systems, and corporate culture (Stevenson, 2008), but areas like sourcing can also face consequences. In the case of SMC, there were too many acquisition processes happening simultaneously and, in order to keep the production continuity as well as to establish communication between sites, sourcing issues were not necessarily a priority. In other words, as long as the suppliers kept the new factories running, it was not an urgent need to consolidate the supply base of the organization, once there were many other urgent matters.

Therefore, it can be concluded the SMC is a very interesting subject to be studied from a sourcing perspective. The company has a very unusual case of a very big amount of acquisitions in a small period of time, less than ten years. With the more urgent matters under control, other issues can be addressed and SMC has shown an interest to create its own process for reducing its supplier base. Based on the literature (Ogden and Carter, 2008; Ferrin and Plank, 2002; Oh and Rhee, 2010), the chosen methods for developing a process are, primarily systematic elimination and, secondarily tiering.

4.3 Company Interface

As explained previously, in order to complete this study several months were spent at SMC Tampere in action research determining the most suitable method for supplier base reduction. As when considering Sandvik AB, or SMC as a global company there are thousands of suppliers, hence, a division within the company was chosen. However, when choosing a study area, several factors had to be taken into account to make this study as general as possible, so that the whole company could profit from the results. Before determining the units focused by the study, it is necessary to introduce SMC's organizational chart and the relevant subdivisions for the study.

Sandvik AB is divided into three areas, mining and construction, tooling and materials technology. Inside the mining and construction division, there are three customer segments: surface mining equipment, underground mining equipment and construction equipment. In addition to these three divisions, there are two supporting divisions, supply chain and marketing & sales. These divisions are depicted in Figure 11 below.

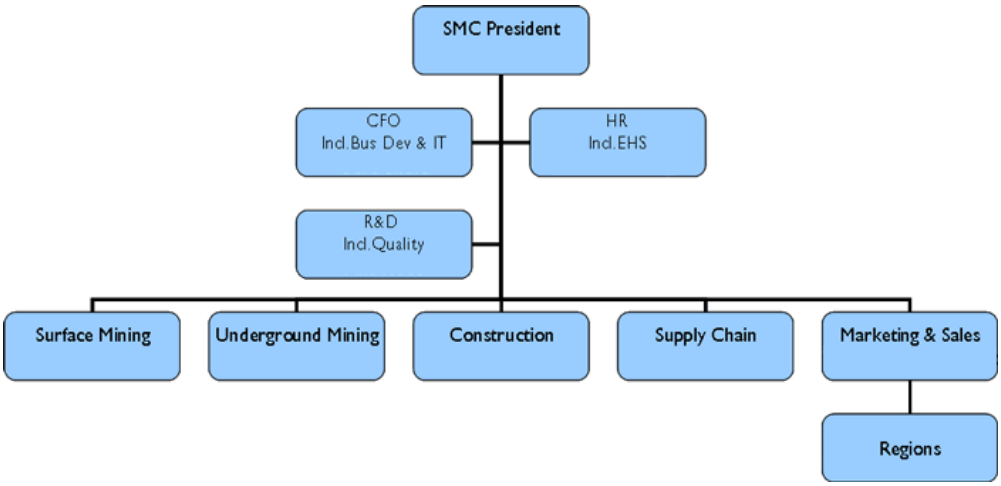

Figure 11. SMC Organizational Chart

As a matrix organization the three customer segments are also managed under the supply chain. Therefore, the supply chain division has authority over all the customer segments and manages all the related activities. Sourcing belongs supply chain division and its businesses support all SMC production units in all segments. As shown in Figure 12 below sourcing is one of the main activities in the supply chain division.

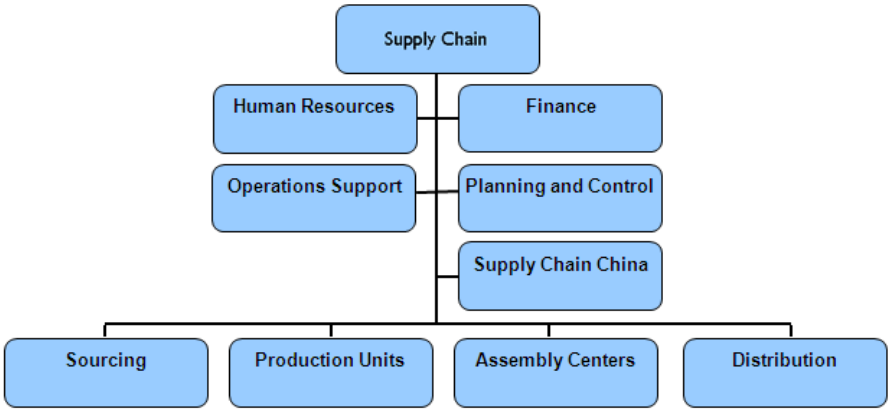

Figure 12. Supply Chain Division Organization

Sourcing is also divided in a matrix system that consists of five category teams and five regions (which are ultimately divided in production units). All but one production units fall under the regions, the logistics one. Logistics supports SMC globally with spare parts as an aftermarket business. Therefore, in the attempt of having a process as generalized as possible, the aftermarket unit was chosen, as it has global coverage. Nevertheless, this unit has thousands of suppliers, and analyzing this big supplier base would be extremely time-consuming and even complicated to start. Instead of using all the five categories existent, one of them was chosen, the vehicle and mechanical

components (VMC) one. The VMC category has 28 subdivisions called sub-categories. These subcategories were segmented according to the matrix presented in section 2.4.1, and from those five were targeted to be in this study. The segmentation criteria were for the sub-categories that had low supply risk, so that no major mistakes could have been made in the company. Finally, after positioning its suppliers on the matrix mentioned, a sample of 200 suppliers was chosen. These suppliers are placed in the following continents: Americas, Europe, Africa, Asia and Oceania. However, the representation of Asian suppliers is reduced due to the fact that, as shown in Figure 12, China has its own supply chain division. SMC Logistics has three distribution centers that cover the globe, as represented by Figure 13.

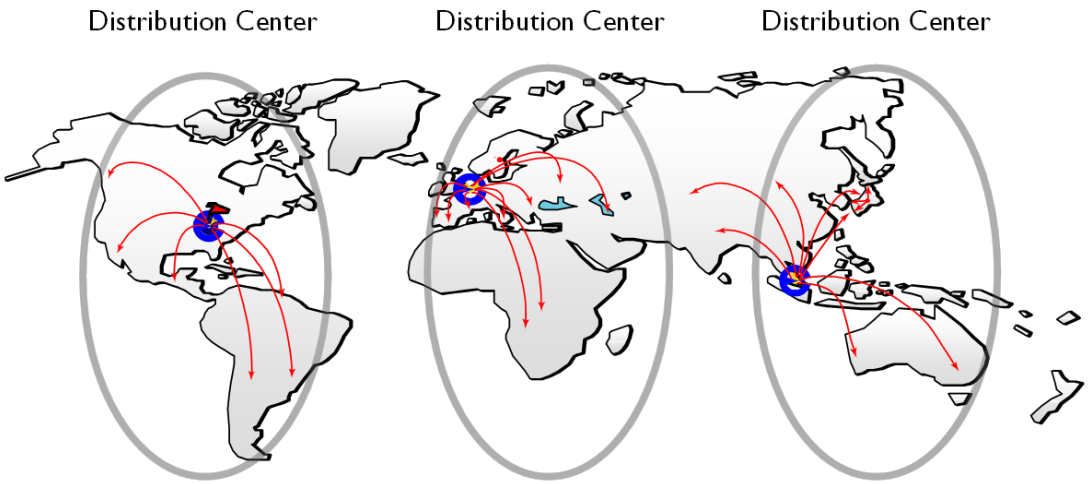

Figure 13. SMC Logistics aftermarket division

The goal for this study within SMC was to reduce between 10 and 15% of the amount of suppliers from the sample chosen. In order to achieve such goal a framework and a process were developed. This chapter introduced Sandvik AB as company as well as its division Sandvik Mining and Construction. The consolidation process lived by the company was emphasized and the interface between researcher and company was detailed. The following chapter presents the results of the study, process for creation of the framework and process, as well as the approach and how to apply them.

5 RESULTS: SUPPLIER BASE REDUCTION FRAMEWORK AND PROCESS

This chapter will present the results obtained with the supplier base reduction project in SMC. In order to succeed with the supplier base reduction a two-step approach was developed. First a framework based on the elimination criteria was created based on the theory, then it was developed with SMC workers. This framework development idea was to tailor it to SMC's needs and reality. Once the final model was ready, the supplier base provided for the study was fully classified according to the framework.

The second step was to develop a process to eliminate the targeted suppliers. However, this process had certain basic rules to follow, such as it had to be reproducible, thorough and effective. This process is the four phase table shown as a timeline in section 3.4.1, except that for the study itself the process was much more detailed, as it is shown in this chapter. The chapter starts with the description on how the framework was created and how it was used. Then, there is the description of the creation of the process to actually eliminate the suppliers.

5.1 Framework for reducing suppliers

5.1.1 Development of the framework

Based on the literature research an initial framework design was developed in order to begin the interview phase. The initial conception of this framework is shown in chapter 2, in the last section. The list compiled from the sources presented in chapter 2 was used as a base to develop a tailored framework for SMC. The initial criteria based on the literature review were:

- Annual spent
- Delivery service
- Information available internally
- Geographic location
- Supplier/Product Performance
- Request for quotations (RfQ)
- Reliability
- Value added by supplier

Based on this list a different arrangement was created so that dimensions could be added to each of the criterion. Figure 14 shows the first layout used

to be presented to the interviewees. The initial phase of the framework did not have any dimensions to the criteria, once the most relevant development was related to the determination of the best criteria, considering both the literature and the interviewees' opinion.

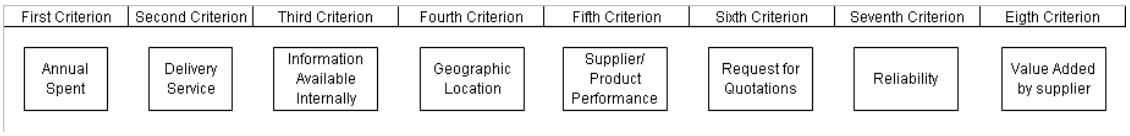

Figure 14. Initial Framework Presented to Interviewees.

During the interviews the SMC employees were presented with the image shown by Figure 14, and they were asked to analyze and make comments about it. In order to achieve the best fit for the company, employees from different departments and hierarchical levels were questioned. At a determined point of the interview, the interviewees had the chance to add or remove whichever criteria they wanted in order to tailor the framework to their needs. After the interviews, the results were compared to the literature and the information available in the ERP systems in order to have a functional and applicable framework. The contributions made by SMC employees are shown in Table 5.

Table 5.Contribution from the different interviewees to the final result.

Employee's title	Add	Remove
Global Sourcing Project Manager	Delivery accuracy	-
Operative Purchasing Manager	Order volume, last order's date	Number of purchased items
Purchasing Engineer	–	Last order's date
Site Sourcing Manager	Number of production units supplied	–
European Team Leader of Global Sourcing	Amount of products bought, Staff opinion	Request for Quotations
Global Head of Production	–	Supplied units in Sandvik
Global Sourcing Category Manager	Production units in Sandvik supplied	–

As it can be seen, there were not many variables that were changed from the initial framework, confirming the validity of the theory in practice. Some of the points that were added, took a more practical approach, while some others to

a softer approach towards the selection of criteria. Some of the added and removed criteria provided some curious insights. For example, the Operative Purchasing Manager, believes it is important to have the last order's date as one criterion to be determined. While his employee, the Purchasing Engineer disagreed completely with his boss and stated:

> *"The last time we ordered a component is extremely variable and does not add any actual value to classifying suppliers for elimination. The main reason for this is that we deal with products that have lead times of a couple of days and products whose lead time are a couple of months. Because of that we will have a very big disparity among the last order's dates, and I see no reason to use that as an elimination criterion."*

Another curious approach taken by one of the interviewees was to add a softer approach to the framework. The European Team Leader of Global Sourcing suggested that the staff handling the suppliers should be asked whether a supplier should or not be involved in the reduction process. It was very interesting to obtain these results from the interviews once it adds the particularity of the SMC case to the solution of the problem. Also, it helped confirming that the literature research done was on stop with the "real world" reality, except a few changes.

In addition to the unexpected results just mentioned, the interviewees also recombined slightly the criteria presented and explained why they would do such changes. The main change, perhaps noticed was that some of the criteria presented were removed to be evaluated under some other criterion. According to the interviewees, reliability, delivery service and performance can be consulted together with the staff opinion. The main reason for that was that in order to identify accurately these dimensions about a supplier one must have enough knowledge about it. In addition, to acquire all that information about a supplier, access to several databases are required and, as this project was done in such a short period, it would not be possible to get the access, or the experience to understand the results. Another adding made was by the European Team Leader of Global Sourcing of mentioning that RfQs are not a criterion, but a method of determining prices. Therefore, it was removed from the selection criteria. After re-designing Figure 14 according to the results of the interviews it became as it is shown in Figure 15 below.

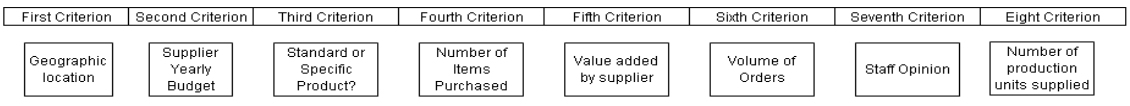

Figure 15. Supplier reduction criteria after the interviews.

After all the interviews were made the final framework was compiled using a similar layout to the one presented in Figure 14. With the final set of criteria to be used to target the suppliers for elimination ready, some dimensions had to be added to each criterion. Adding dimensions to the criteria determined is what makes it possible to classify suppliers. Furthermore, the dimensions for each criterion had to be mutually exclusive, so that a supplier would either fall in one or another dimension easily. Basically, the dimensions also had to be easily evaluated and the information widely accessible. Figure 16[1] shows the result achieved.

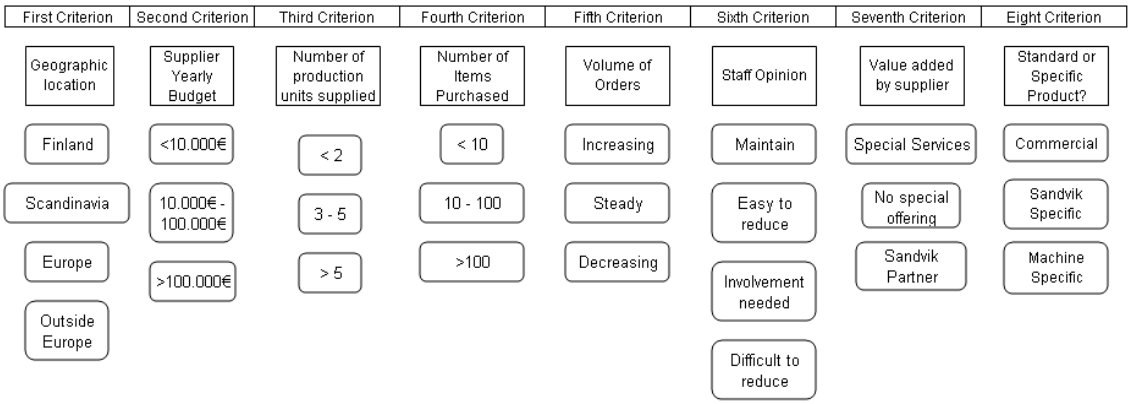

Figure 16. Conceptual framework developed for supplier classification.

The idea while compiling the framework presented in *Figure 16* was to have a simple process that could be applied in the future, by any SMC worker. Moreover, this framework is supposed to be generic enough to be applied throughout SMC globally. The following section will briefly describe what each of the eight criteria stands for and why they were chosen to be part of the final framework.

5.1.2 Criteria breakdown

This section will breakdown all the criteria used in the framework presented and describe what exactly each one of them is aiming to evaluate. *Geographic Location* aims to determine where the supplier's production unit or warehouses are located. In this criterion there is a compromise to be made while evaluating which of them is more prone to be eliminated. On one hand, a centralized supply unit for a whole region reduces the number of suppliers for the whole company. In addition, prices and services can be negotiated with a much higher bargaining power from the buying company due to the increased demand of several production units, for example. On the other hand, having a

[1] Figure 16 is also presented in Appendix 1 for a more detailed view of the framework

centralized supply unit in a region can result in increased delivery costs, lead time and supply risk. While having several local suppliers can reduce those, but this commitment tends to reduce bargaining power, once one unit might not require a significant amount from a local supplier. Therefore, prior to deciding whether is better to have local to regional suppliers the "cost vs. amount of suppliers" decision must be made.

Supplier yearly budget refers to the annual spent used in a supplier. Basically, this criterion aims to eliminate the suppliers where SMC spends less money than what it costs to maintain a supplier. Cost estimations were made to determine how much money SMC uses to manage each of its suppliers. In the cost estimate, Ferrin and Plank's (2002) study was used as a basis to determine which cost drivers influence supplier costs. Four categories of indirect costs were used to determine supplier indirect costs: purchasing, sourcing, material receiving and IT. The final sum divided by the amount of suppliers gave the cost per supplier, which was established to be 10.000€[2]. The three divisions established in this criterion were: less than the cost of managing one supplier (<10.000€), cost between 1 and 10 times the cost (>10.000€ and <100.000€) and more than ten times the cost (>100.000€).

Number of production units supplied refers to what was mentioned with the first criterion: whether a centralized supplier handles more than one unit within a region. Again, this is a measurement of how difficult it can be to eliminate a supplier, as it is very demanding to conduct common efforts in several production units to be able to eliminate one supplier. However, this is not a crucial factor, and there can be suppliers that are connected to more than five PU's and still are targeted for elimination. *Number of items purchased* is a simple division that aims to establish how many components would have to be resourced in case the supplier is to be replaced. An arbitrary value was determined in this case based on an analysis performed in SMC's databases, to determine the amount of suppliers that have the smaller quantity of items in the sample given to be analyzed in this study.

Volume of orders helps to understand why, sometimes, some of the suppliers have no history in SMC's databases or why such a big supplier in the past has so small amount of orders. The criterion aims to evaluate the trends in supplying history to understand better if a supplier can be targeted for elimination or not. Sometimes, there are cases where what seems to be a small supplier is in fact a replacement and is meant to be a Sandvik partner. While, there are cases where known big companies provide a very small

[2] The values shown were changed in order to protect SMC's intellectual property.

amount of units, which usually means that the supplier is being eliminated gradually.

Staff opinion is, perhaps, the most important criterion in this list. With the help of staff that is managing suppliers on a constant basis it is possible to get very detailed information on many issues. Purchases, account manager and general sourcing personnel are aware of issues such as delivery accuracy, quality of products, quality of services, reliability and performance. However, it is not possible to consult the personnel constantly for this kind of information once they are busy and this requires time. Hence, usually the staff is consulted after a pre-screening process to avoid constant inquires and disturbances.

Value added by supplier is a criterion used to protect SMC's partners from being targeted to elimination. This criterion is very simple to be analyzed and aims to, in case a supplier needs to be replaced, inform the sourcing personnel of which kind of supplier that one is: provides no special offering, special services (such as packaging, delivery to SMC's clients, kanban, among others) or is a Sandvik partner in business.

Finally, *standard or specific product* is the criterion that tells how easy or difficult it is to replace a supplier. Ideally all items classified as commercial are easily replaceable and have several suppliers in competition against each other. However, in practice this is not always the case but, in order to keep the model simple, it is assumed that commercial items are easily replaceable. The second and third divisions are for products that were specifically designed to attend Sandvik's requirements. This design can qualify in two of the supplier-buyer interfaces presented in section 2.4.2, translation or interactive. In other words, these are parts that are produced specially for Sandvik and the supplier was required to put specific effort to adapt its production line for such parts. Therefore, the replacement of these two types of supplier requires the involvement of many stakeholders and, due to the short period of this study, these two divisions of the third criterion were left out of this project.

This section detailed the eight criteria used in the framework developed to target suppliers for elimination. The next section presents how to use the framework and what are the aims of such a design. Moreover, further information on the application and implications of the use of the framework are presented.

5.1.3 Application of the framework

The framework consists of eight criteria divided into 3 or 4 factors depending on the complexity. Basically, the goal is to classify the supply base of the company into the criteria presented, and further on to analyze suppliers by the different groups they fall in. Therefore, when applying all the criteria presented to the supplier base it would be possible to filter such base to a small group of suppliers. A more in-depth analysis should be done to the suppliers in the targeted group in order to determine which ones should be kept in the base and which ones should be eliminated.

As mentioned previously, the framework developed attempts to provide a simple enough model so that basically any SMC worker can use it. In addition, most of the criteria used are easy to evaluate even with a great number of suppliers. Yet, some of the criteria require a more in-depth analysis per supplier in order to choose one of the dimensions. Therefore, these criteria have been further divided into prescreening and specific analysis. The order the criteria were placed in the framework has the purpose of dividing these two further divisions as it can be seen from Table 6.

Table 6. Division of elimination criteria

Prescreening	Specific
1. Geographic Location	6. Staff Opinion
2. Supplier Yearly Budget	7. Value added by supplier
3. Number of Production Units Supplied	8. Standard or Specific Product
4. Number of Items Purchased	
5. Volume of Orders	

The basic difference between prescreening and specific criteria is when these criteria are applied to the sample list of suppliers. As the amount of suppliers chosen for this study is quite big (200 suppliers), the easier way of approaching their evaluation is to apply the criteria that can be done in a more general level. Then, after targeting the potential suppliers to be eliminated, the specific criteria are analyzed. Figure 17 shows an example on how to apply the framework to a supplier. The idea of this is to have certain groups of suppliers that have bigger potentials when considering the supplier base reduction process.

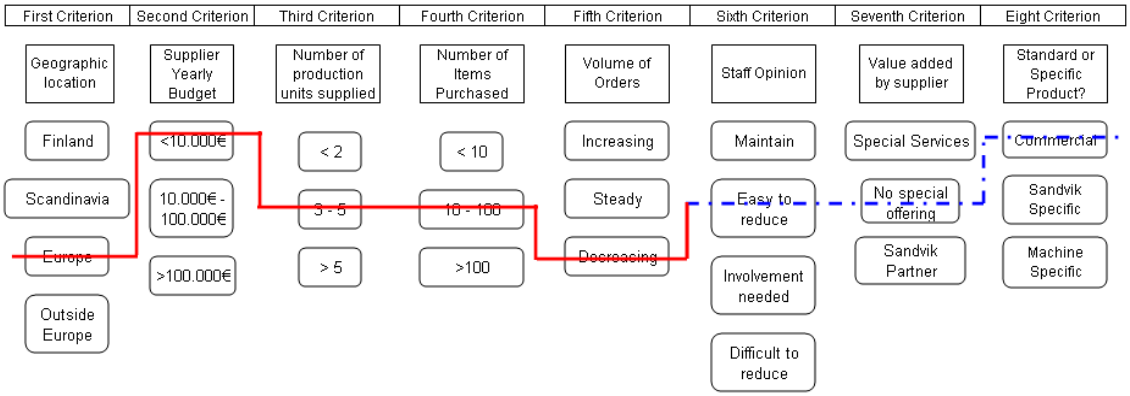

Figure 17. Example of application of the supplier base reduction framework.

The supplier presented in the example in Figure 17 could be supplying bearings, bolts and nuts or basic industrial components, for example. There might be special cases even after selecting the suppliers with these eight criteria, however, each selection group presents the likelihood of having potential suppliers to be eliminated from the database. As it can be seen from the figure above, the straight line is the prescreening analysis, applied to all suppliers. The dashed line represents the criteria that are applied only to the suppliers short-listed to be eliminated.

This section presented the framework for reducing the supplier base, explained how it was created, what the criteria mean and how it should be applied. The continuation of the supplier elimination process is presented in the next section, along with the four step process developed and a complete flowchart of all the actions taken during the construction of this process.

5.2 Process for reducing supplier base

The process developed for reducing the supplier base consists of a four step model that involves several stakeholders and analyses. The four step timeline introduced in section 3.4.1 is based on a process that will be explained in more detail in the next sections. These four steps in the implementation process of supplier base reduction are: supplier database analysis, analysis of components, supplier replacement and final supplier reduction. The four steps of the process can be seen in Figure 18.

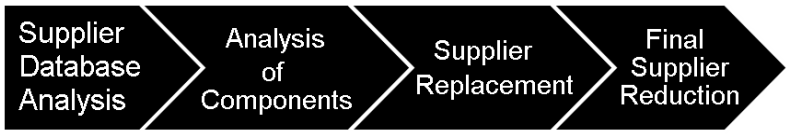

Figure 18. Four steps of the supplier base reduction process.

The following sections will detail each of the four steps, the sub-steps involved and the stakeholders involved. Once all the four steps have been introduced a flowchart will be presented to summarize the whole process in one figure.

5.2.1 Supplier database analysis

The supplier base reduction process begins by determining the scope of the project. As SMC has several divisions, as well as component categories, there has to be a limitation to which component classes will be analyzed. For this study the division was the following:

- Logistics division
- VMC team
- Low-risk and low value added suppliers
- Standard commercial items as fasteners, bearings and seals

This initial division resulted in a sample of 200 suppliers located in all continents in the world. Once, this step is taken, the framework developed for supplier base reduction is used. As mentioned previously, the framework is divided into two types of criteria, prescreening and specific. For this phase of the process the prescreening criteria are applied to all suppliers. The prescreening criteria are: geographic location, supplier yearly budget, number of PU's supplied, number of items purchased and volume of orders. With these criteria applied, it is possible to re-organize the supplier list in any convenient way to make the process easier.

Based on the classification made, an analysis step is started to evaluate which suppliers are more prone to be eliminated from the supplier base. In the case of this project, the goal was to eliminate the suppliers that cost more than they are used (spent lower than 10.000€[3] annually). In addition to that there can be other trends such as small amount of PU's supplied and decreasing volume of orders. This analysis is subjective and the more the evaluator is experienced, more accurate this tends to be. In addition to the criteria used, company

[3] This value was changed in order to protect SMC's intellectual property.

websites are also a valuable source of information, especially to understand if the company's missions are equivalent to SMC's, as well as information about warehouse locations, production facilities, etc.

The final part of the supplier database analysis process is to target suppliers for reduction and submit the results to the responsible stakeholders. In this case the stakeholders involved in the process were sourcing personnel, in general site sourcing managers, who are the most qualified to delegate tasks among their teams. The feedback received will approve or reject the suppliers in the shortlist provided. Based on the local PU's personnel approval, the list is ready to be submitted to the following step, analysis of components. Table 7 shows the sub-steps and the stakeholders involved in the first step of the reduction process, supplier database analysis.

Table 7. Sub-steps and stakeholders involved in supplier database analysis.

Sub-steps	Stakeholders
Determine scope of project	Project manager
Apply prescreening criteria	–
Analyze list and target possible suppliers	–
Specialist opinion: proceed or not with targeted suppliers	Local site sourcing manager and his/her team

As it can be seen from the table there are four sub-steps in this phase and not much stakeholder involvement needed. However, considering the fact that site sourcing managers have several tasks, this can be a long process. One possibility for decreasing the idle time when the specialist opinion is required is to have a contact in each site involved that has as part of his/her responsibility to be part in the supplier base reduction project. The following section will describe the following step in the process.

5.2.2 Analysis of components

Once a short-list of potential suppliers to be eliminated is formed, it is time to analyze the complexity of the components to be replaced. Basically this step involves gathering a folder with all the necessary information that would be sent to a potential replacement supplier. However, before compiling an extensive supplier profile, the remaining criteria from the framework must be filled. So, staff opinion was already somehow used in the last sub-step of the first phase. Hence, the only missing criteria are determining the value added

by the supplier and whether its components are standard (commercial) or specifically designed for Sandvik.

The first part consists of analyzing the shortlist of suppliers with the remaining criteria. The main difficulty is to discover whether the items bought are standard or not, once technical knowledge is required. However, based on the component category (e.g. bearing or seals), and on the technical specifications found in the SMC ERP systems, a rough estimation can be made. Nevertheless, this estimation has to be confirmed by a staff member, preferably a buyer or a sourcing specialist.

Once all the criteria from the framework are complete, the actual folder with all the supplier data can be built. For this it is important to have all parts names and numbers, amount of units bought in history or per year, prices paid, among others. In addition, all the technical specifications which are necessary to get the components from other supplier need to be added to the folder. The main issue on that is when the supplier analyzed belongs to some other PU than the one where the researcher is working at. That is because of all the mergers and acquisitions SMC was faced with in the previous decade, not all the acquired companies have a common product data management system. Hence, other stakeholders must be involved in the process to guarantee that all the parts have the correct info. Table 8 shows the sub-steps and stakeholders involved in the analysis of components phase.

Table 8. Sub-steps and stakeholders involved in the analysis of components step.

Sub-steps	Stakeholders
Apply specific criteria	–
Gather technical specifications for components	–
If necessary - Contact stakeholders to get missing information	Buyers, account managers, product engineers, suppliers, inventory managers, etc.

The most critical sub-step in this component analysis phase is clearly the last one, in case it is necessary. However, due to the broad scope of this project, it is often necessary to require technical information from local personnel. This tends to delay the process, once the involvement of more than one of the stakeholders listed might be necessary. Also, when delegating tasks like that, with a researcher status in the company, the control over the process is passed towards other parties. Because of this delegation system, the process has proven to be significantly slower when other parties are involved. Yet, due to the lack of authority of the researcher, that was the only way found to

execute the required steps. The continuation of the process is to find possible replacements for the component set assembled.

5.2.3 Supplier replacement

When choosing a replacement to the supplier to be eliminated starts with assuring that all the required technical specifications and drawings of the parts to be resourced are in order. To find a replacement to the chosen suppliers works on the reverse order of choosing suppliers to eliminate. In other words, this means that by using the prescreening criteria of the framework on the suppliers that were chosen to be left in the supplier base can be a method of choosing the substitutes. An example of chosen criteria for a replacement supplier can be seen in Figure 19.

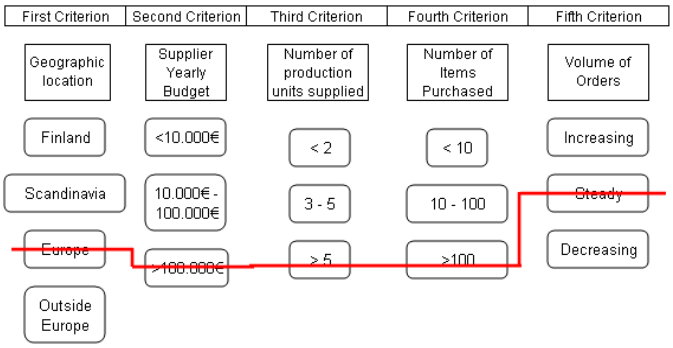

Figure 19. Example of profile of supplier that can replace once to be eliminated from the base.

In addition, to finding the suppliers that fit to a chosen profile, e.g. the one in Figure 19, there has to be approval on the supplier based on hard data. Some examples of hard data are delivery accuracy, quality of products and commitment to the relationship (e.g. changes of orders and common cost reduction efforts). Once the replacement is approved to take the new orders it is necessary to check whether R&D department involvement is mandatory or not. An example of when R&D involvement is necessary is when a part is not commercial and needs to have its quality and conformity approval by SMC engineers. Nevertheless, R&D involvement can take a long crucial time for the project. Hence, it must be determined with the project manager if the substitution continues in case R&D needs to be involved or not. In case no further involvement is needed, the project manager can simply approve the substitution and then RfQs can be sent to determine prices. The required sub-steps in this phase, along with the involved stakeholders are presented in Table 9.

Table 9. Sub-steps and stakeholders involved in the supplier replacement phase.

Sub-steps	Stakeholders
Compile all components data in a folder	–
Shortlist possible substitutes	–
Get replacement approval	Buyer, account manager or project manager
If R&D needs to be involved – go or no-go decision	Project manager, R&D department, testing engineers
Get approval to proceed	Project manager
Request for Quotation	Local sourcing personnel, Project Manager

This, in general, is quite a quick phase once the main aim for this project is to eliminate the so called “easy” suppliers. Therefore, R&D is out of the picture in this case and the main stakeholder involved is the project manager, who wants to see the project moving. Yet, some of the information might be difficult to assess (e.g. quality of the supplier that will be the substitute) and personnel from other PU’s may be requested to step in. Despite the fact that in general this is a rather quick phase, the RfQ sub-step can be fairly long. From the moment of requesting the quotation to the moment of receiving an offer can last more than four months. The reason for this delay is unknown, once suppliers should be eager to get more on their plate to increase their sales and, hence, their profits. So, no good justification was found to explain the longevity of this process. However, this was one case during the whole study. After obtaining the RfQ, a confirmation from the project manager or local sourcing personnel is required. Finally, the full substitution is made. The next section will explain how the final phase happens.

5.2.4 Final supplier reduction

The final phase of the supplier base reduction process is basically a wrap-up. During this stage the replacing supplier already has sent back the quotation for the components and such quotation has been accepted by SMC personnel. This phase involves more IT stakeholders that manage the databases than sourcing professionals. In this phase of the process it must be checked if all the parts that belonged to the eliminated suppliers have been moved to other suppliers. Hence, the replaced supplier’s account must be closed in the databases to ensure that no new orders are placed. As mentioned previously, SMC has several databases due to the M&A, so it must be checked that in all of those the new supplier is the official one.

In addition to database updates and IT involvement, there is a need to document the process so that, in case this project is continued or someone in another PU wants to execute something similar, there will be a starting point. Therefore, the documentation of the process is important, and in the case of this project, this study is the documentation. Table 10 shows the sub-steps of this phase with the involved stakeholders.

Table 10. Sub-steps and stakeholders involved in the final reduction phase.

Sub-steps	Stakeholders
Replace part codes in databases	IT department, Sourcing personnel
Close old accounts	IT department, Sourcing personnel
Document the process	–
Follow up	–

As it can be seen from the table above there is a final sub-step to this phase, the follow up. The follow up stage is to understand the consequences of the replacement process. Basically the idea is to evaluate if the new situation is better or worse than previously and the reasons. This kind of evaluation is important to understand the implications of such kind of process and to give feedback for the continuation of the process. The following section will wrap-up this whole process into a flowchart in order to make it visual so that users of the process can track better the progress.

5.2.5 Reduction process flowchart

By combining the fully developed process into one whole system, a flowchart was created to make the comprehension of the process simpler. The four phases and the sub-steps presented in the previous sections were all compiled together in the programming form. As mentioned in the objectives of this study, this project's goal is to make any SMC employee capable of executing this process. Hence, this flowchart is an attempt to clarify the process to all capable professionals in the company. The four phases of the project are divided by color, as it can be seen from Figure 20, or Appendix 2. This flowchart initial idea was to help the researcher in keeping track of the phases and how to proceed from beginning to end. However, it became part of the results as it is a detailed explanation of the process in one image.

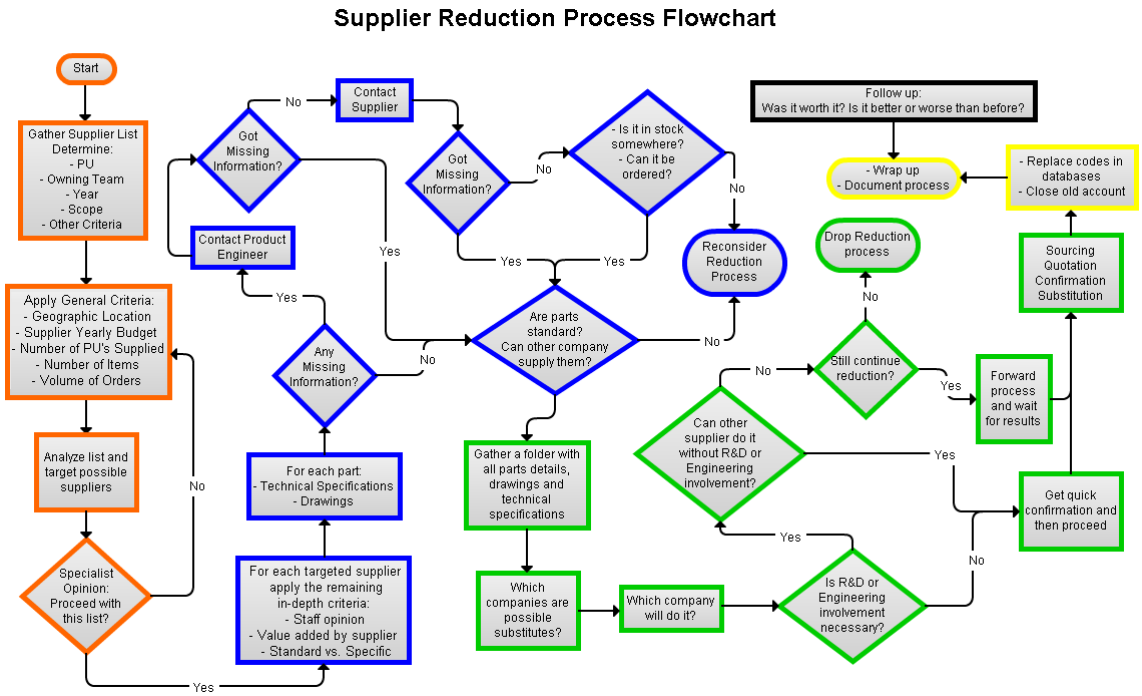

Figure 20. Supplier reduction process flowchart.

This chapter presented the results obtained during this study, performed at SMC Tampere. The first part of the chapter presented the development of a framework to classify and target possible suppliers to be eliminated from SMC's supplier base. It explained how the framework was developed with the help of interviews and how the participants added to the final version of the model. Then, it explained how the framework is used and t difference between the prescreening and specific criteria. The second part of the chapter detailed how the process developed to reduce the number of suppliers is used. The four phases of the project were introduced in details, and the final flowchart was presented. The next chapter will discuss the results obtained as well as conclude the study.

6 DISCUSSION & CONCLUSIONS

Business reality has been changing constantly over the past decades, trends such as outsourcing and mergers and acquisitions became an integrant part of several companies. However, in some cases, this can result in increased numbers of suppliers, which end up in indirect cost increases. Therefore, a new trend, especially in the automotive industry, has begun to appear: reducing the supplier base to a more easily manageable number. Yet, the literature covers very little on how to target the suppliers that can be eliminated from a supplier base.

The objective of this study was to understand the factors that are taken into account when targeting suppliers for elimination, and to provide an analytical tool to have a more systematic way of choosing them. Moreover, the goal was to develop a framework with certain criteria relevant both to the academic world and to the industry reality. The process chosen was to combine literature review with interviews, in order to validate the criteria from an industrial perspective. Furthermore, action science was used to test the applicability of the framework developed.

A literature review was performed in order to determine the most relevant criteria while choosing suppliers for elimination. In addition, SMC workers were presented with the criteria studied from the literature and were given the chance to add or remove any of them. Combining the result obtained with the available information in Sandvik databases, it was possible to create a framework that helps finding suppliers to be included in the supplier base reduction process. By applying the framework and determining the correct groups, employees will have a basic understanding on which are the suppliers that are most likely to be eliminated from the base.

In addition to the framework, there was a goal for creating a process and an implementation method that could be practically applied in SMC. The process was developed as the project progressed and a step-by-step model was created, along with a six-month implementation plan. The result was a four-phase model that consisted of supplier database analysis, analysis of components, supplier replacement and final supplier reduction. The detailed version of this four-phase model became a flowchart with all the sub-steps involved, as well as a stakeholder analysis. The following sections will discuss and conclude this thesis in more detail.

6.1 Results from the research and research questions

In this thesis a framework and a process for reducing the number of suppliers in SMC was developed. The problem in the company is that it went through an intense process of mergers and acquisitions that resulted in a large supply base, which contains many overlapping suppliers. The objective for this project was to create a process and test it in the SMC global logistics reality to optimize such base. In addition, there was a goal of creating a standard process that could be reproduced in different parts of the world.

Therefore, the research problem was developed in a way that would consider the current reality of SMC and the need for developing a method that would be capable of successfully targeting and eliminating “unnecessary” suppliers. The research questions were: 1. How can a process such as supplier base reduction be standardized? 2. What are all the stakeholders involved in such kind of project and what kind of cooperation is needed from them? 3. What kind of subjective data are needed in a supplier base reduction process? 4. Is SMC ready to take part and invest in supplier base reduction? These questions will be answered from a more empirical side, giving details and examples of the project unfolding.

For *the first research question* the answer is yes it can be standardized, with limitations. The results chapter of this thesis showed not only a standardized method for classifying and targeting suppliers for reduction, but also a process that, if followed thoroughly, produces the required results. Literature shows that supplier base reduction processes have had little or no attention from researchers and this study aims to cover such area (Ogden and Carter, 2008). Especially the part of developing a more standardized way for both selecting and eliminating suppliers. Automotive industry practices have shown through lean sourcing practices that the more standardized, the more effective a supply chain can be (Emerald, 2005). As one of the first studies aiming to fill this gap in the literature, this project provides an insight on one possible method for eliminating suppliers in a systematic way. However, there is still a long way to go before having a complete systematic method, since the one developed still is subjective to one’s interpretation of the process.

The second research question involves the stakeholder involvement in a supplier elimination process. As shown in chapter 6, the four-phase process listed the most significant stakeholders involved in the reduction process, from the scope definition until the final supplier reduction phase. To kick-start the process the sole stakeholder (despite the researcher/executor of the task) involved is the project manager. Hence, no delays or long delays tend to happen once the project manager is the responsible for conducting it and is

the one that has the best interest in having a fluid execution. After the scope definition, it is up to the task executor to analyze the database and prepare a shortlist of possible suppliers to be eliminated. Once the analysis is ready there is the need for involving other stakeholders. In this case, sourcing personnel that have knowledge of the supplier base can give feedback on the list and approve/reject the suppliers listed. Again, normally, this is a quick process. However, without a personal touch or persuasion systems, such as calls and e-mail reminders, this process can last more than a few months.

During the second phase of the process, basically, the only stakeholder involved is the task executor, unless there are problems with finding the needed information, or no access to certain databases. In case missing information is needed buyers, account managers, product engineers, suppliers, inventory managers or other professionals have to be involved. As proven by the researchers experience, due to the amount of different databases and PU locations, it is high likely that other parties will need to be involved in the data gathering process. The third phase is definitely the one that involves the most stakeholders in the whole process. The reason for such high dependence on other parties is that this phase requires approval from several departments such as sourcing, purchasing, R&D and testing, as it can be seen from Table 11. Nonetheless, this high dependence can be avoided by increasing the authority of the person who executes the supplier base reduction. Yet, in case the person is new to the company he/she may require more support. The final phase of the process is basically a wrap-up and the difficult parts of the work have already been done. Therefore, even if there are different departments involved there is a higher tendency of cooperation, once it is easier to visualize the result of the project. In this phase IT and sourcing departments are involved. To summarize the answers of question number two, Table 11 was created:

Table 11. Answer to the 2nd research question, stakeholders involved during the reduction process.

Phase	Stakeholder	Task
1	Project Manager	Define scope
	Sourcing department	Approve supplier shortlist
2	Sourcing, R&D, Engineering, Storage departments	Provide missing information on components
3	Sourcing/Purchasing	Substitute approval, RfQ
	R&D/Engineering	Testing and approving new components
	Project Manager	Approve replacement, continuation decisions, RfQ
4	IT/Sourcing	Replace part codes in databases, Close old accounts

The third research question is related to the subjectivity of the supplier reduction process. The answer is that the process is actually subjective. Supplier base reduction is highly based on databases analysis, evaluation, and especially approval. An interesting approach was taken to evaluate the subjectivity of the stakeholders' evaluation: two different people from the same department were asked about the same supplier, and while one said the supplier should be kept, the second recommended it to be eliminated.

In addition, when consulting account managers or personnel highly involved with supplier interactions, several suppliers were classified as “special”. However, when evaluating the parts supplied, they were many times found to be either commercial, or based on simple standard drawings or specifications. In general, as Anderson and Jap (2005) argue, the closer the relationship between buyer/manager and supplier is, the more biased it tends to be. Therefore, the authors recommend rotating the interface in order to maintain professionalism on the relations (Anderson and Jap, 2005). Another option to solve this issue is to have some straight-forward criteria that are considered unacceptable for suppliers, and use them strictly. So, in case suppliers do not fulfill the minimum requirements, they must be removed from the supplier base. One example to back-up the existence of “special” suppliers is to check how many suppliers were targeted in the bearings category, and how many were said to provide special parts. Bearings in general are standard parts, however sometimes there can be cases of actual special designs. Nonetheless, it is interesting to see how many “special” bearing providers are

needed. From a total of 60 bearing suppliers in the logistics division, 20 were initially targeted to be resourced[4]. From those, some were miscategorized as bearings and some were inactive, a total of 30% falls under this category. 35% were approved to be eliminated, while another 30% were classified as special suppliers. The remaining 5% were double entries in the system. As these numbers show, a simple way of keeping a big supplier base is classifying many partners as special providers, while the technical specifications do not confirm this affirmation.

The final research question aims to evaluate whether SMC is ready to take part in the supplier elimination process this research was asked for. The answer is not so simple. The company is ready to *start* a process, with restrictions. As this was a global scale project, it was possible to evaluate the readiness of the personnel throughout the globe, and based on the cooperation given the readiness was evaluated. Dividing the operations into four areas, the most representative ones, it was obtained: Africa, Australia, Europe and North America. Africa has a small representation of the amount of suppliers targeted for this project, less than 5%. However, the initial cooperation was high, and it decreased with time. Therefore, the region is ready for the process, but it requires some strong management in order to ensure cooperation. Australia was the very different, it seemed in the beginning that there would be no cooperation, but after some time there was some cooperation. Nevertheless, in the end it was nearly impossible to handle the situation. In this case, the main reason is that the acquisitions in Australia are quite recent and the synergy between sites is not at its best yet. Hence, the region is not yet ready for this project.

Europe, on the other hand, was, by far, the most cooperative region of all. Perhaps, due to the small distances between countries or to the more advanced synergy between sites. Independently of the reason, site sourcing managers, as well as other personnel were very cooperative and the process advanced faster in this region. Therefore, this region is the most suitable to develop the supplier reduction process. As for North America, it was the most difficult region to handle. Since the very beginning of the project the stakeholders were the ones who took longer to cooperate. Strong interaction was attempted in the form of e-mail reminders and phone calls. Nevertheless, no change on the attitude was seen, and the reasons behind it are not clear. In order to execute this project in North America, there would be a need to assess the reasons for the behavior seen, and a specific time plan traced. As

[4] These values were changed in order to protect SMC's intellectual property.

for the present moment, this region is not ready for a supplier base reduction project.

Finally, the main result for the execution of the reduction process is to evaluate the success rate of the fulfillment of the goals. The project was started in mid-March, and the timeframe for its execution was six months. At the moment this thesis was written, the process had been undergoing for five months and the results were somehow promising. In order to test the framework created a random sample of 200 suppliers was used, and the goal was to eliminate between 20 and 30 suppliers. With the help of the framework a shortlist of 45 suppliers were targeted for elimination and 22 were approved and on the process of being eliminated. The successful eliminations during the timeframe mentioned were 5 suppliers. Due to the unexpected long period taken for replies, approvals and the high stakeholder involvement, it is not possible to predict on how long the project still will take. However long, the process developed can be considered a success, despite the unexpected events during the execution phase. Also, the holiday season (July-August), throughout Europe and North America, contributed to the slower pace than predicted in the first place.

6.2 Contribution of the thesis to prior research

The supplier elimination process is a topic that still has not been fully covered in the literature, and this is the main contribution of this thesis. Despite the lack of researcher and literature, the topic still does not have specific defined terms for such process. Therefore, this study suggests that the terms supplier base reduction and supplier elimination can be used as general terms to standardize the key-words for this topic. Ogden and Carter's (2008) study is basically the only one found whose topic is directly related to this subject.

Also, this study adds to Ogden and Carter's (2008) approach one other major form of reducing the supplier base interface, bundling is not mentioned in such study. However, when considering the full approach existent in the literature, this thesis brings up a different selection method, as well as a different process. Hence, by enabling readers to be able to compare different models and draw their own conclusions, this study adds to prior research. In a subject where literature is so scarce, models, frameworks and processes can change significantly the *modus operandi*. The approach taken in this study suggesting to consider supplier targeting for elimination as supplier selection can be one of this big changes in the way of working. Moreover, by performing a combination of literature research and the establishment of selection criteria for elimination will save researchers' time on the ground work enabling the

research to reach a more practical than theoretical level. As it can be seen from Table 13, in addition to what was found on previously published literature, this study adds two more items to supplier selection for elimination.

Table 12. Contribution of this study to the literature.

Criteria	Clarke and Freytag	Ogden and Carter	Svensson	Wilson	This study
Annual spent			x		
Delivery service			x		
Information available internally	x	x			
Geographic location	x				
Supplier/Product Performance			x	x	
Request for quotations (RfQ)		x			
Reliability					
Value added by supplier's services ***or special products***	**x**	**x**		**x**	**x**
Volume of orders					**x**
Staff's Opinion					**x**

Table 3

Table 12 is a modified version of Table 3 presented in section 2.6. The proposed changes to the initial criteria found are highlighted. The first change is adding the relevance of specially designed products for the company. These products are usually specially designed, require a long process to be sourced from different suppliers and targeting this kind of suppliers is not recommended as an initial approach to the reduction process. The second change is adding a more strategic criterion to the list. By analyzing the volume of orders it is possible to follow trends and see if a supplier has been slowly eliminated from the base, or the opposite. In addition, a longer term plan can be designed and some suppliers can be targeted for gradual elimination. Finally, the third change is to add a more subjective approach to the analysis, asking the direct responsible for the suppliers can provide valuable information that could not be obtained otherwise.

The last main contribution made by this thesis is the four-phase process developed, supplier database analysis, analysis of components, supplier replacement and final supplier reduction. This process is better detailed in section 6.2 and also brings a step-by step process and the stakeholders involved in the process tailored for SMC. However, the researcher believes this process can be expanded to other companies in different industries. To finalize this section, the main contributions from this thesis were: filling the gap in the literature in supplier base reduction; developing a set of criteria to select supplier for elimination and develop a process for reducing the supplier base.

6.3 Limitations

Even if the objectives were achieved and the framework proved valuable, there were several limitations encountered during the study. The main practical limitation on the project was due to the high importance of networking, at several moments during the execution of the supplier reduction process tasks the process got stuck. There were several reasons for that such as, little or no will to cooperate with the project, low priority according to stakeholders' points of view and employees were too busy with their own tasks. The main reasons for these implementation limitations were probably the innovativeness of the project, as well as the "it is working mentality, there is no need to change anything". In addition, more practical limitations were poor communication between sites as well as a big amount of ERP systems. Also, as SMC is a multinational company, there are thousands of employees and it is very challenging to contact the right stakeholder in the first place. Hence, there is a long process to discover the correct responsible for the task. Finally, the last practical limitation faced was the high stakeholder involvement in the project, which slowed the operations significantly.

As for the theoretical limitations of this study, there are also several. The principal is that neither the selection criteria nor the process were statistically tested in different organizations. The only testing field was SMC, hence, the generalization of the findings to other areas or companies should be made with restrictions. Also, the project was tailored for one PU in SMC, the logistics one, specifically for some of the vehicle and mechanical components. Therefore, even when generalizing the frameworks presented inside the company, it should be done with caution to first assure that the generalizations is actually possible. The proposals suggested in this thesis were tailored for SMC, and they are suggested to the current situation faced in SMC.

6.4 Ideas for future research

For future studies, it would be interesting to link this framework with other supply positioning frameworks and to have a more analytical way of placing suppliers in them. Still in this area, more supplier selection criteria could be researched and tested for selection of suppliers for elimination. The framework for selection suppliers can be further tested and perfected within SMC itself, as well as other companies in different industries. Also, inside SMC, supplier databases can be analyzed fully with the framework determining the percentage of suppliers that can be eliminated from each group. In this case performing a statistical analysis on how many suppliers, in average, are targeted for elimination based on the framework. Following this train of thought, the validity of the supplier selection framework could have its validity tested in SMC or other context. As mentioned previously, this study lacks the statistical approach to generalize the models presented to other industries and companies, which gives potential for further research of the current model. Another possibility is testing the validity of the model inside SMC itself, for more specific PU's and other categories than VMC.

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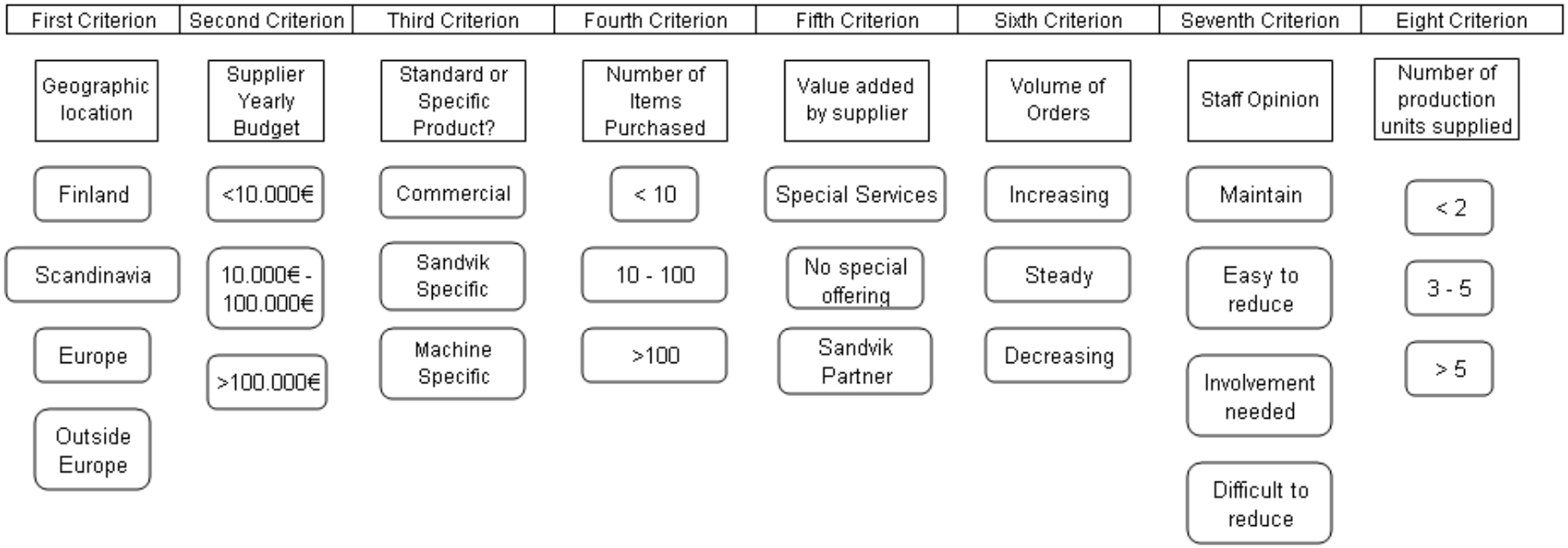
APPENDIX 1: CONCEPTUAL FRAMEWORK DEVELOPED FOR SUPPLIER CLASSIFICATION


First Criterion
Second Criterion
Third Criterion
Fourth Criterion
Fifth Criterion
Sixth Criterion
Seventh Criterion
Eight Criterion
Geographic location
Supplier Yearly Budget
Standard or Specific Product?
Number of Items Purchased
Value added by supplier
Volume of Orders
Staff Opinion
Number of production units supplied
Finland
Scandinavia
Europe
Outside Europe
<10.000€
10.000€ - 100.000€
>100.000€
Commercial
Sandvik Specific
Machine Specific
< 10
10 - 100
>100
Special Services
No special offering
Sandvik Partner
Increasing
Steady
Decreasing
Maintain
Easy to reduce
Involvement needed
Difficult to reduce
< 2
3 - 5
> 5

APPENDIX 2: SUPPLIER REDUCTION PROCESS